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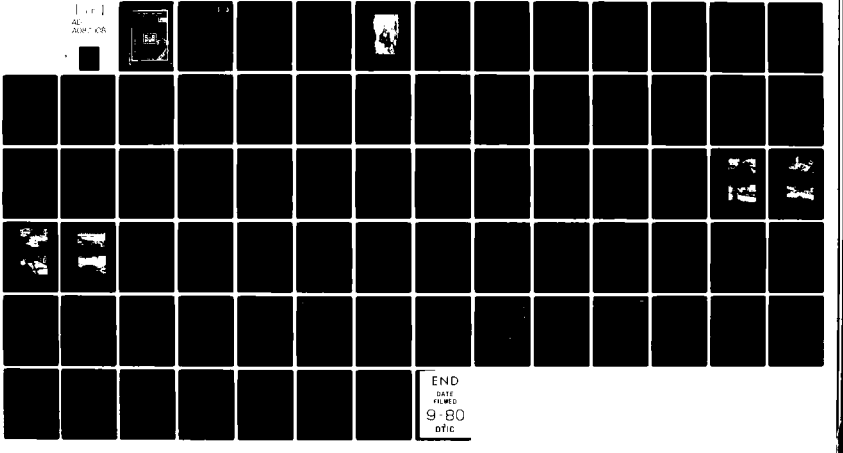

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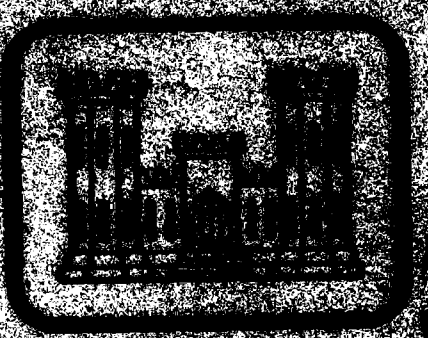
PIKE COUNTY, PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



PREPARED FOR

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

BY

Berger Associates, Inc.
Harrisburg, Pennsylvania

PREFACE

This report has been prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITIONS AND RECOMMENDATIONS

Name of Dam:	LOWER HEMLOCK DAM
State & State No.:	PENNSYLVANIA, 52-117
County:	PIKE
Stream:	TRIBUTARY TO ROCK HILL CREEK
Date of Inspection:	April 2, 1980

Based on the visual inspection, past performance and the available engineering data, the dam and its appurtenant structures appear to be in fair condition.

In accordance with the Corps of Engineers' evaluation guidelines, the size classification of this dam is small and the hazard classification is high. This indicates that the Spillway Design Flood (SDF) for this dam should be in the range of one-half the Probable Maximum Flood (PMF) to the full PMF. The recommended SDF for this structure is one-half the PMF. The spillway capacity is adequate for passing 67 percent of the PMF without overtopping the dam. The spillway is therefore considered to be adequate.

The following recommendations are presented for immediate action by the owner:

1. That all brush and trees be removed from the embankment slopes and that a professional engineer, experienced in the design and construction of dams, be consulted for the removal of tree stumps and roots.

2. That the fish guard-screens on the spillway weir either be removed or attached in such a manner that they can be easily removed during periods of high discharges.

3. That the seepage near the outlet pipe be observed on a regular basis. If discoloration or an increased quantity is detected, measures should be taken to locate the origin and to correct the condition.

4. That the valve in the valve chamber be greased and operated at least once each year.

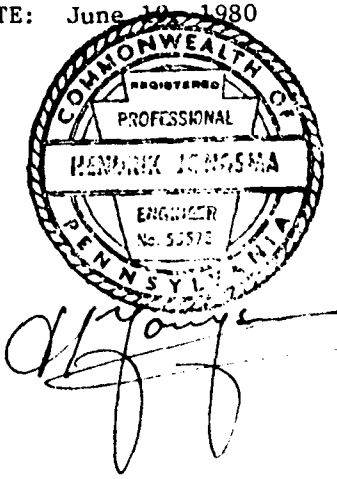
5. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.

6. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

SUBMITTED BY:

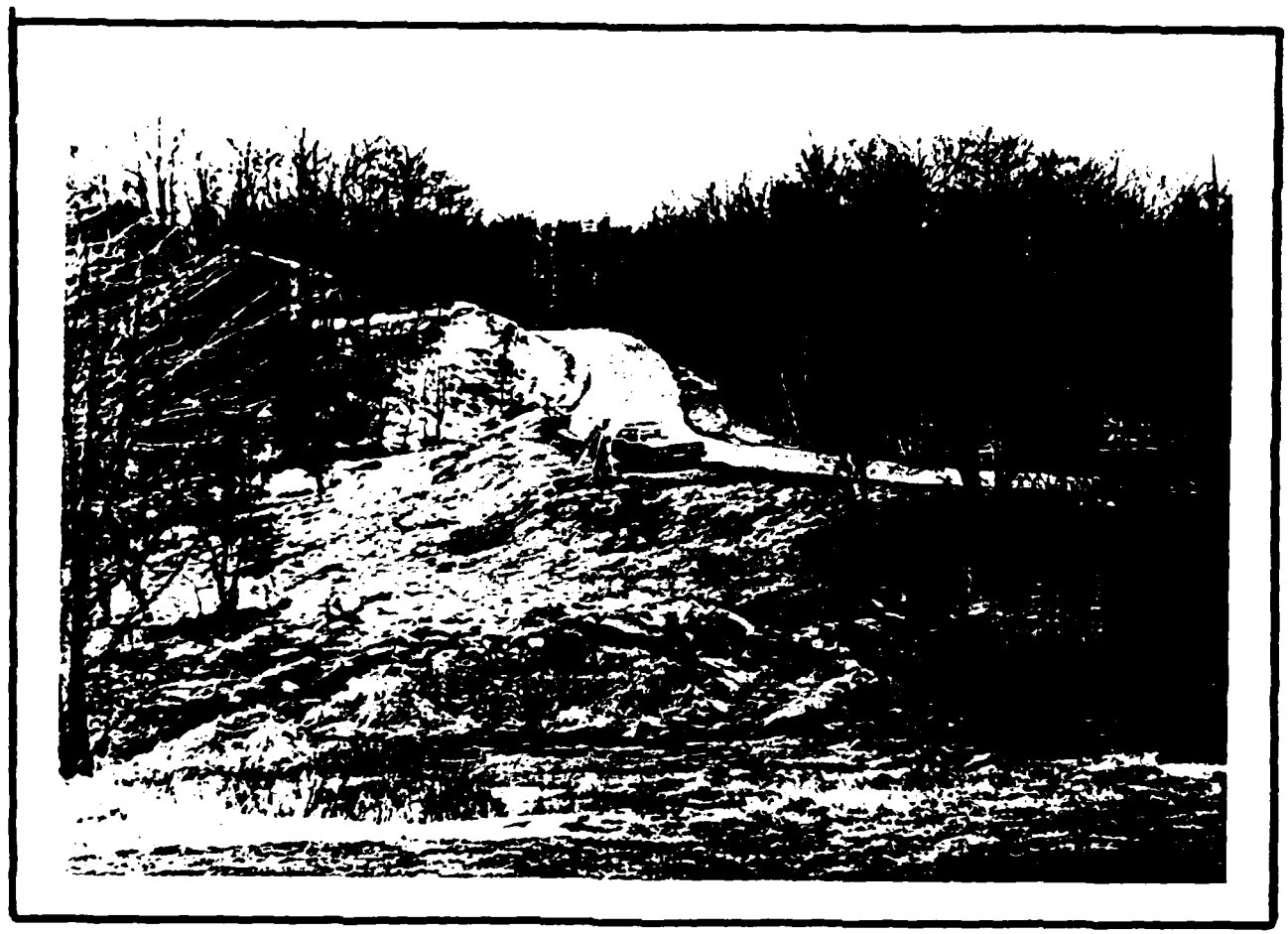
BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

DATE: June 10, 1980



APPROVED BY:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer
DATE 11 July 1980



OVERVIEW

LOWER HEMLOCK DAM

Photograph No. 1

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LOWER HEMLOCK DAM

NDI-ID No. PA-00756
DER-ID No. 52-117

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

A. Authority

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspections of dams throughout the United States.

B. Purpose

The purpose of this inspection is to determine if the dam constitutes a hazard to human life and property.

1.2 DESCRIPTION OF PROJECT

A. Description of Dam and Appurtenances

Note: Normal pool level is estimated at Elev. 1432.0 from the U.S.G.S. quadrangle map. This elevation is used as top of spillway elevation in this report. Construction drawings indicate top of spillway elevation at Elev. 41.0.

Lower Hemlock Dam is a 420 foot long earthfill structure with a maximum embankment height of 15 feet. Plate IV, Appendix E, indicates a concrete core wall along the centerline of dam. The top of the dam is used as a public roadway and has a bituminous surface.

The spillway is located near the left abutment of the embankment. A fish guard-screen is attached to the upstream side of the concrete ogee section. The roadway crosses the spillway discharge channel immediately downstream from the weir (Photograph 7, Appendix C). The bridge is a concrete slab deck structure supported on two piers and two abutment walls. The outlet control structure is constructed differently from that shown on Plate IV, Appendix E. It actually consists of a valve

chamber with the valve located on the inside of the upstream wall. Water is discharged directly into the valve chamber and flows from there through a 24inch diameter outlet pipe under the embankment to the downstream toe. The valve chamber is covered with a large overhanging concrete slab and is accessible by a footbridge from the crest of the dam, (Photograph 5, Appendix C).

Lower Hemlock Dam is about 1200 feet downstream of the Upper Hemlock Dam.

B. Location: Blooming Grove Township, Pike County
U.S.G.S. Quadrangle - Pecks Pond, Pa.
Latitude 41°-17.6', Longitude 75°-02.7'
Appendix E, Plates I & II

C. Size Classification: Small: Height - 15 feet
Storage - 394 acre-feet

D. Hazard Classification: High (Refer to Section 3.1.E.)

E. Ownership: Mr. David R. Kochel, Community Manager
Hemlock Farms Community Association
Hemlock Farms
Box 1007
Hawley, PA 18428

F. Purpose: Recreation

G. Design and Construction History

The dam was designed by the Engineering Department of George M. Brewster & Son, Inc., Bogota, New Jersey. Mr. Brewster was the owner of and contractor for the dam. The structure was constructed in 1947 without a permit. An application for a permit was filed with the Pennsylvania Department of Environmental Resources (PennDER) on October 13, 1948, and a permit for construction was issued on April 13, 1949. The dam was constructed in the general area of a previous stone dam.

H. Normal Operating Procedures

The reservoir is used for recreation and all inflow is discharged over the spillway. There are no operating procedures.

1.3 PERTINENT DATA

A. Drainage Area (square miles)

From files:	1.7
Computed for this report:	1.36
Use:	1.36

B. Discharge at Dam Site (cubic feet per second)
See Appendix D for hydraulic calculations

Maximum known flood (estimated from U.S.G.S. gage records of Mill Creek at nearby Mountainhome, Pa.)	514
Outlet works low-pool at pool Elev. 1425.0	24
Outlet works at pool level Elev. 1432.0 (spillway crest)	47
Spillway capacity at pool Elev. 1435.3 (low point of dam)	1012

C. Elevation (feet above mean sea level)

Top of dam (low point)	1435.3
Spillway crest	1432.0
Upstream portal invert (estimated gate opening)	1421.5
Downstream portal invert	1419.0
Streambed at centerline of dam (estimate)	1420.0

D. Reservoir (miles)

Length of normal pool	0.25
Length of maximum pool	0.25

E. Storage (acre-feet)

Spillway crest (Elev. 1432.0)	307
Top of dam (Elev. 1435.3)	394

F. Reservoir Surface (acres)

Top of dam (Elev. 1435.3)	29.9
Spillway crest (Elev. 1432.0)	23.1

G. Dam

Refer to Plates III & IV in Appendix E for plan and section.

Type: Earth embankment with concrete core wall.

Length: 440 feet.

Height: 15 feet.

Top Width: Design - 20 feet; Survey - varies, maximum 38 feet.

Side Slopes:	Design	Surveyed
Upstream	2H to 1V	3.2H to 1V
Downstream	3H to 1V	2.2H to 1V

Zoning: Concrete core wall to Elev. 1433.0.

Cutoff: Concrete core wall in trench to rock or impervious material.

Grouting: None.

H. Outlet Facilities

Type: 24" diameter pipe.

Location: Near right abutment.

Closure: 24" valve in control chamber at upstream toe.

Upstream Invert: 1421.5

I. Spillway

Type: Concrete ogee section with fish screen.

Length: 47' with two piers, each 21".

Crest Elevation: 1432.0

Location: Near center of dam.

Bridge: Concrete superstructure located 3' downstream of ogee crest, underclearance elevation 1434.

J. Emergency Outlet

See Section 1.3.H.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The engineering design data for Lower Hemlock Dam are limited to the design drawings prepared by the design-contractor-owner of the facilities. The drawings do not indicate that borings were made. Embankment stability or seepage calculations are not available for review. The set of design drawings has eight separate drawings of which five detail the bridge, two detail the embankment and one is the title sheet. The only available hydraulic calculation is one prepared by PennDER indicating that the spillway capacity is 760 cfs.

2.2 CONSTRUCTION

The dam was constructed before a permit for construction was issued. Records of progress reports of construction are not available in either the PennDER or the owner's files.

2.3 OPERATION

Records of operation have not been maintained by the owner. The reservoir was lowered for maintenance work on the dam, beaches and boat ramps in 1959, 1965, 1969 and 1978.

2.4 EVALUATION

A. Availability

The available engineering data, consisting of a set of design drawings, are located in the files of PennDER at Harrisburg, Pennsylvania.

B. Adequacy

The available engineering data combined with a visual inspection are considered to be sufficiently adequate to make a reasonable assessment of the embankment and its appurtenant structures.

C. Operating Records

Operating records, including maximum pool levels, have not been maintained by the owner.

D. Post Construction Changes

Comparing the design drawings with the present condition of the dam indicates that changes have occurred either during or after construction. The roadway has been widened to include a parking area

(Photograph No. 1), and a vertical stone wall is located near the downstream toe (Plate A-I, Appendix A). The valve box is located near the upstream toe and the outlet pipe is not continuous through the valve chamber. Four screened openings are in the valve chamber just above normal pool level (Photograph No. 5, Appendix C).

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general appearance of Lower Hemlock Dam is fair. Trees are growing on the upstream slope and some seepage was noticed on the downstream slope. A fish guard-screen located on the spillway weir could cause some clogging of the opening and thus could reduce the spillway capacity. The valve on the outlet was in good condition.

The visual inspection check list and sketches of the general plan and profile of the dam, as surveyed during the inspection, are presented in Appendix A of this report. Mr. Thomas K. Clauss represented the owners and accompanied the inspectors.

Photographs taken on the day of inspection are reproduced in Appendix C.

B. Embankment

The upstream slope has a good riprap protection and appears to be flatter than the design slope above the normal pool elevation. Trees have been planted on this slope to enhance the surroundings. Tree roots are not desirable on an earth embankment and it is recommended that the trees be removed. The top of the dam is one of the main roads in this residential development. A bituminous road surface covers most of the dam crest. Longitudinal cracking in this surface appears to be normal pavement distress. The dam is located in a low area between two hillsides. The profile (Plate A-II, Appendix A) indicates that the crest of the dam is in a sag, with only a short low area.

The downsteam slope is very irregular due to a natural high ridge near the center of the embankment (Plate III, Appendix E) and by the apparent placement of spoil material near the right abutment. This spoil consists of large boulders. Fine material has been washed out between these boulders creating what appears to be "sink holes." This area is downstream from the actual toe of the dam and the condition is not considered serious. A section of the downstream toe is formed by a two to three foot high loose-laid stone wall. Some seepage was noticed through this wall near the outlet pipe. Although some discoloration (reddish) was noticed in the water, the distance to the reservoir and the presence of the large rocks and stone indicates that this condition is not serious. Some trees are located in the spoil areas and above the wall.

C. Appurtenant Structures

The spillway weir and spillway abutment walls are in good condition. Only minor deterioration was noticed. The fish guard-screen on top of the weir, about 1.5 feet high, is not desirable. Clogging could occur and reduce the efficiency of the spillway. The bridge and supporting piers carrying the road over the spillway were in good condition.

The valve chamber is accessible from the crest of the dam. The top of the valve chamber is 2.8 feet above normal pool elevation. The platform is large and overhangs the actual chamber on all sides. A long valve stem, which is stored inside the chamber, can be lowered through a hole in the slab to the top of the valve. The valve was operated during the inspection and is in good condition.

D. Reservoir Area

The upstream end of Lower Hemlock Lake is formed by the Upper Hemlock Dam. The slopes of the reservoir are moderate and the wooded banks appear to be stable.

E. Downstream Channel

The immediate downstream channel has a rocky bottom and is relatively wide and flat. About 4000 feet downstream, the creek outlets into Blue Heron Lake. This reservoir is lined with homes along its banks and is about 100 feet lower in elevation than Lower Hemlock Lake. A potential hazard to loss of life exists if the dam fails. The hazard category is considered to be "High."

3.2 EVALUATION

The overall visual evaluation of Lower Hemlock Dam indicates that the dam is in fair condition. The seepage condition at the downstream toe is not considered serious at the present time but should be observed on a regular basis. The trees on the upstream slope should be removed and it is recommended that the fish guard-screen on the spillway also be removed.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The dam and reservoir were constructed for enhancement of the area and to be used for recreation. The reservoir level is maintained at spillway crest elevation with all inflow above this level being discharged over the spillway. The pool is lowered when needed for maintenance requirements of surrounding beaches and boat docks.

4.2 MAINTENANCE OF DAM

There is no apparent maintenance of the embankment. Trees have been planted on the upstream slope.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only operating facility is the drawdown valve located in the valve chamber. Mr. Clauss, the owner's representative, stated that this valve was last operated in 1978. It was partially opened during this inspection. There are no maintenance procedures.

4.4 WARNING SYSTEM

There is no formally organized surveillance and downstream warning system in existence at the present time.

4.5 EVALUATION

The operational procedures for Lower Hemlock Dam are minimal at the present time. It is recommended that the trees on the upstream slope be removed and that the valve be greased and operated at least once each year. A formal surveillance and downstream warning system should be developed for implementation during periods of high or prolonged rainfall.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. Design Data

The hydrologic and hydraulic analysis available from PennDER for Lower Hemlock Dam was not very extensive. No area-capacity curve, frequency curve, unit hydrograph, design storm, design flood hydrograph, nor flood routings were available. A computation sheet in the PennDER files indicated that the spillway design capacity was 760 cfs.

B. Experience Data

There are no records of flood levels at Lower Hemlock Dam. Based on records of the U.S.G.S. stream gage on Lower Hemlock Creek at nearby Mountainhome, Pa., the maximum inflow to Lower Hemlock is estimated to be 514 cfs. This flood was passed apparently without difficulty.

C. Visual Observations

A fish guard-screen is installed at the upstream face of the ogee weir. This screen has the potential for becoming blocked by debris and thus considerably reducing the spillway capacity. No other conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event until the dam is overtopped.

D. Overtopping Potential

Lower Hemlock Dam has a total storage capacity of 394 acre-feet and an overall height of 15 feet above streambed. These dimensions indicate a size classification of "Small." The hazard classification is "High" (See Section 3.1.E.).

The recommended Spillway Design Flood (SDF) for a dam having the above classifications is in the range of one-half the Probable Maximum Flood (PMF) to the full PMF. Because of the size of this dam, the recommended SDF should be one-half PMF. For this dam, the SDF peak inflow is 721 cfs (See Appendix D for HEC-1 inflow computations).

Comparison of the estimated SDF peak inflow of 721 cfs with the estimated spillway discharge capacity of 1012 cfs indicates that a potential for overtopping of the Lower Hemlock Dam does not exist.

E. Spillway Adequacy

The small size and high hazard categories, in accordance with the Corps of Engineers criteria and guidelines, indicates that the SDF for this dam should be in the range of one-half PMF to the full PMF. The recommended SDF for this dam is one-half PMF.

Calculations show that the spillway discharge capacity and reservoir storage capacity, based on the present low point in the dam profile, combine to handle 67% of the PMF (Refer to Appendix D).

Since the total spillway discharge and reservoir storage capacity can pass the SDF without overtopping, the spillway is considered to be adequate.

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

A. Visual Observations

1. Embankment

The visual inspection of Lower Hemlock Dam did not detect any signs of embankment instability. The field survey indicates that the embankment slopes vary from the design slopes. The slopes, however, are considered to be adequate for the height of the dam under consideration. The profile of the dam indicates that the top is at or above design crest elevation. The "sink holes" near the right downstream abutment appear to be caused by fill washing out of large boulders placed here during or after construction. The boulders are located beyond the actual downstream toe. The seepage near the outlet pipe could be caused by a spring. The root system of the trees on the upstream slope could cause stability or seepage problems and should be removed.

2. Appurtenant Structures

The spillway located near the left abutment is in apparent good condition. The fish guard-screens are questionable. Debris collecting in front of the screens could reduce the spillway capacity. The outlet and the intake structures are in good condition.

B. Design and Construction Data

1. Embankment

The embankment has a concrete core wall over its full length. The top of the wall is 1.5 feet wide and is at an elevation one foot above the spillway crest. The wall is reinforced with #6 bars at 12" vertical centers and #4 at 18" horizontal centers. The wall was to be keyed two feet in rock or four feet into impervious material. Records of construction and test boring results are not available. The design appears to be satisfactory.

2. Appurtenant Structures

The available construction drawings indicate good design detailing of the structures. Abutment footings appear to be adequate. The ogee section is placed on a deep cutoff wall. If adequate rock or impervious material was available, amounts of expected seepage would be small. It appears that changes were made during construction of the valve chamber. The general appearance of the structures indicate good workmanship and an apparent adequate design.

C. Operating Records

Operating records for this dam have not been maintained by the owner. There are no indications that problems were encountered, except some seepage near the outlet pipe.

D. Post Construction Changes

There are no records of changes to the embankment and its appurtenant structures. Visual inspection indicates changes in the downstream slope of the embankment. It is unknown if these were made at the time of construction or later. A parking area was provided by widening the crest, at the downstream edge. Spoil was placed near the toe and a stone wall was constructed.

E. Seismic Stability

This dam is located in Seismic Zone 1 and it is considered that the static stability is sufficient to withstand minor earthquake-induced dynamic forces. No studies or calculations have been made to confirm this assumption.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

7.1 DAM ASSESSMENT

A. Safety

The visual inspection and the review of the construction drawings indicate that Lower Hemlock Dam is in fair condition and has been designed in accordance with acceptable engineering practices. The field inspection did not detect any signs of instability. The seepage at the downstream toe is not considered serious at the present time.

The hydrologic and hydraulic computations indicate that the combination of storage capacity and the spillway discharge capacity are able to handle 67 percent of the PMF. The SDF for this dam is ½ the PMF, therefore the spillway is considered to be adequate.

B. Adequacy of Information

The design information contained in the files combined with the visual inspection are considered sufficiently adequate for making a reasonable assessment of this dam.

C. Urgency

The recommendations presented below should be implemented immediately.

D. Additional Studies

Additional studies are not required at this time.

7.2 RECOMMENDATIONS

In order to assure the continued satisfactory operation of this dam, the following recommendations are presented for immediate implementation by the owner:

1. That all brush and trees be removed from the embankment slopes and that a professional engineer, experienced in the design and construction of dams, be consulted for the removal of tree stumps and roots.

2. That the fish guard-screens on the spillway weir either be removed or attached in such a manner that they can be easily removed during periods of high discharges.

3. That the seepage near the outlet pipe be observed on a regular basis. If discoloration or an increased quantity is detected, measures should be taken to locate the origin and to correct the condition.

4. That the valve in the valve chamber be greased and operated at least once each year.

5. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.

6. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

APPENDIX A

CHECKLIST OF VISUAL INSPECTION REPORT

CHECK LIST

PHASE I - VISUAL INSPECTION REPORT

PA DER # 52-117 NDI NO. PA-00 756

NAME OF DAM LOWER HEMLOCK DAM HAZARD CATEGORY High

TYPE OF DAM Earthfill and concrete core

LOCATION Blooming Grove TOWNSHIP Pike COUNTY, PENNSYLVANIA

INSPECTION DATE 4/2/80 WEATHER cloudy-cold TEMPERATURE 40's

INSPECTORS: R. Houseal (Recorder) OWNER'S REPRESENTATIVE(s):

H. Jongsma Thomas K. Clauss

R. Shireman

A. Bartlett

NORMAL POOL ELEVATION: 1432 (estimated) AT TIME OF INSPECTION:

BREAST ELEVATION: 1435.25 (design) POOL ELEVATION: 1432.2

SPILLWAY ELEVATION: 1432.0 TAILWATER ELEVATION:

MAXIMUM RECORDED POOL ELEVATION: Unknown

GENERAL COMMENTS:

The general appearance of this facility is good.

NDI NO. PA-00756

VISUAL INSPECTION
EMBANKMENT

	OBSERVATIONS AND REMARKS
A. SURFACE CRACKS	There are no tension cracks evident on the downstream or along the upstream slopes. The top of the dam is a roadway paved with bituminous concrete. Some cracks are evident on the roadway surface but this is due to normal pavement distress.
B. UNUSUAL MOVEMENT BEYOND TOE	No movement of downstream toe.
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	The only evidence of embankment erosion occurs near its right abutment. Here voids have been created between the large crested boulders and the finer soils have been washed away. Because of the large size of the boulders (3'-4'), the area is considered stable.
D. ALIGNMENT OF CREST: HORIZONTAL: VERTICAL:	Horizontal alignment - good. Vertical alignment - Refer to profile Plate A-II.
E. RIPRAP FAILURES	None evident.
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	All abutments appear to be satisfactory.
G. SEEPAGE	Seepage was observed at the toe of the downstream embankment area on both sides of the outlet pipe. Because of the rocks and boulders in this area, the condition is not considered serious.
H. DRAINS	None.
J. GAGES & RECORDER	None.
K. COVER (GROWTH)	Upstream slope - Riprap with Birch trees 3"-4" Ø at top. Top - Paved roadway. Downstream slope - Rock surface overgrown with weeds and grass. Several 8"-12" trees near the bottom of the slope.

NDI NO. PA-00 756

VISUAL INSPECTION
OUTLET WORKS

	OBSERVATIONS AND REMARKS
A. INTAKE STRUCTURE	Valve house located in the reservoir accessible from the top of dam by concrete footbridge.
B. OUTLET STRUCTURE	24" Ø concrete pipe discharging at stone endwall at downstream toe of embankment.
C. OUTLET CHANNEL	Not well defined. Meanders over rocks toward spillway outlet channel.
D. GATES	Sluice gate - 24".
E. EMERGENCY GATE	Same as D. above.
F. OPERATION & CONTROL	Opened in 1978 and partially opened during inspection.
G. BRIDGE (ACCESS)	Concrete footbridge to intake.

NDI NO. PA-00 756

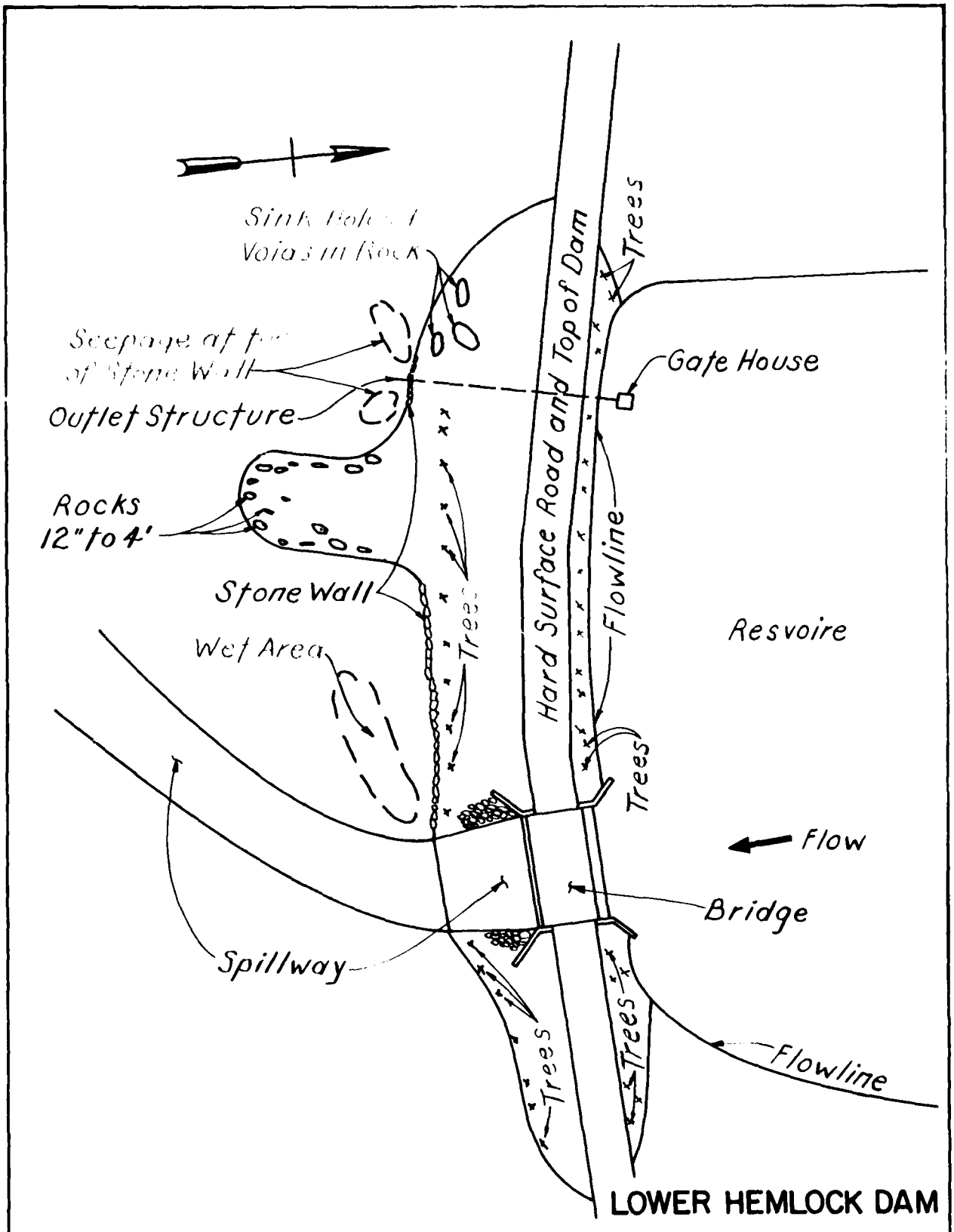
VISUAL INSPECTION
SPILLWAY

	OBSERVATIONS AND REMARKS
A. APPROACH CHANNEL	Approach is directly from reservoir.
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Concrete ogee section weir. All concrete walls and sections are in good condition. Fish screen (1.5' high) spans the spillway crest.
C. DISCHARGE CHANNEL: Lining Cracks Stilling Basin	Discharge channel is natural stream with rocky bottom, grass and trees. The flow meanders freely through this flat area. Numerous trees are in the downstream channel.
D. BRIDGE & PIERS	Concrete slab roadway bridge over spillway channel with two piers.
E. GATES & OPERATION EQUIPMENT	None.
F. CONTROL & HISTORY	No records.

NDI NO. PA-00 756

VISUAL INSPECTION

	OBSERVATIONS AND REMARKS
INSTRUMENTATION Monumentation	None.
Observation Wells	None.
Weirs	None.
Piezometers	None.
Staff Gauge	None.
Other	None.
RESERVOIR Slopes	4:1 to 6:1 grassed and some light woods.
Sedimentation	None reported.
Watershed Description	Residential development in light woods.
DOWNSTREAM CHANNEL Condition	Rocky bottom, relatively wide and flat.
Slopes	Moderate above floodplain - 10°-15°.
Approximate Population	4,000 feet downstream is Blue Heron Lake with about 20 homes close to the edge of the water. Population 60.
No. Homes	20 homes about 4,000 feet downstream.

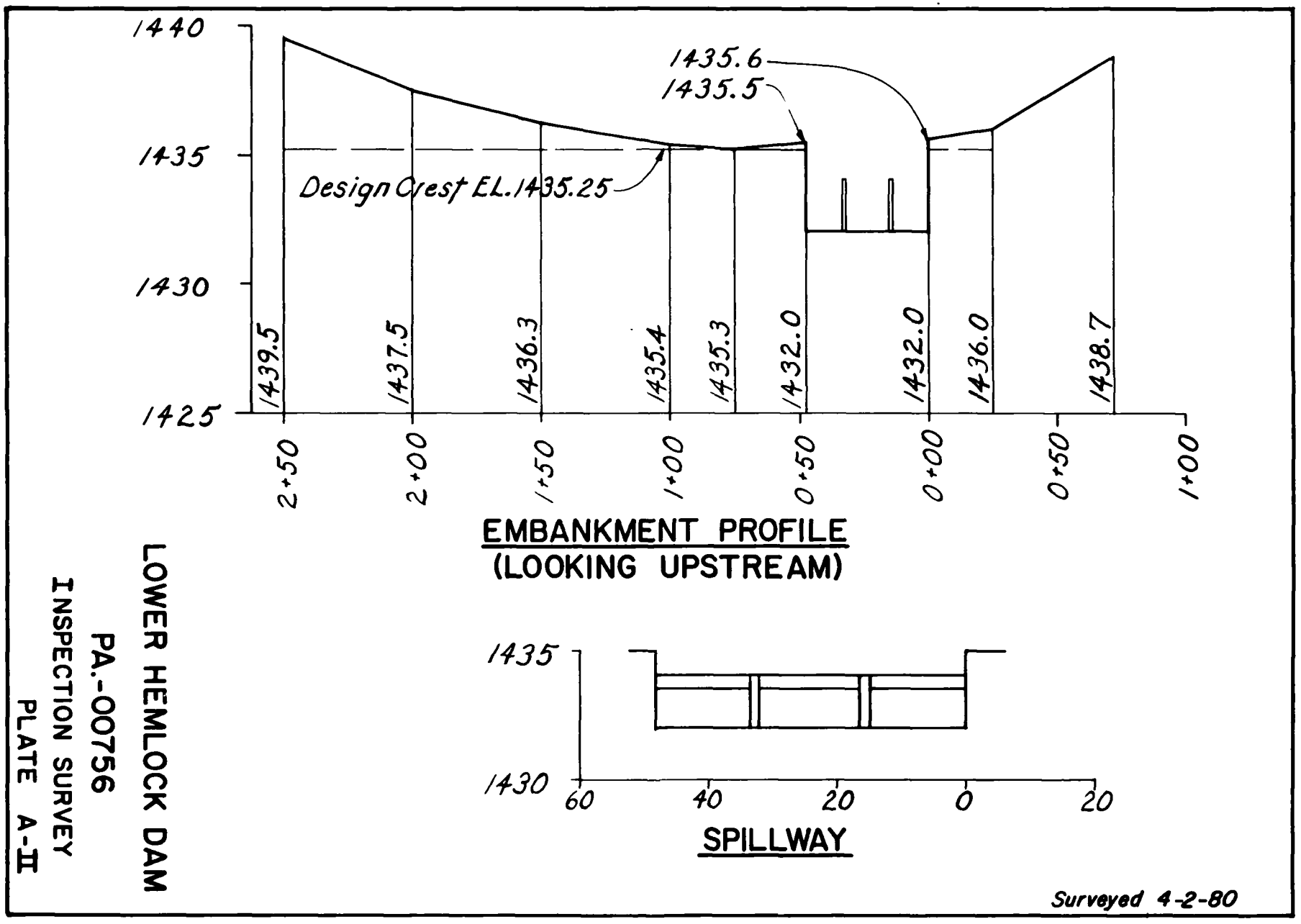


LOWER HEMLOCK DAM

PA.-00756

INSPECTION SURVEY

PLATE A-I

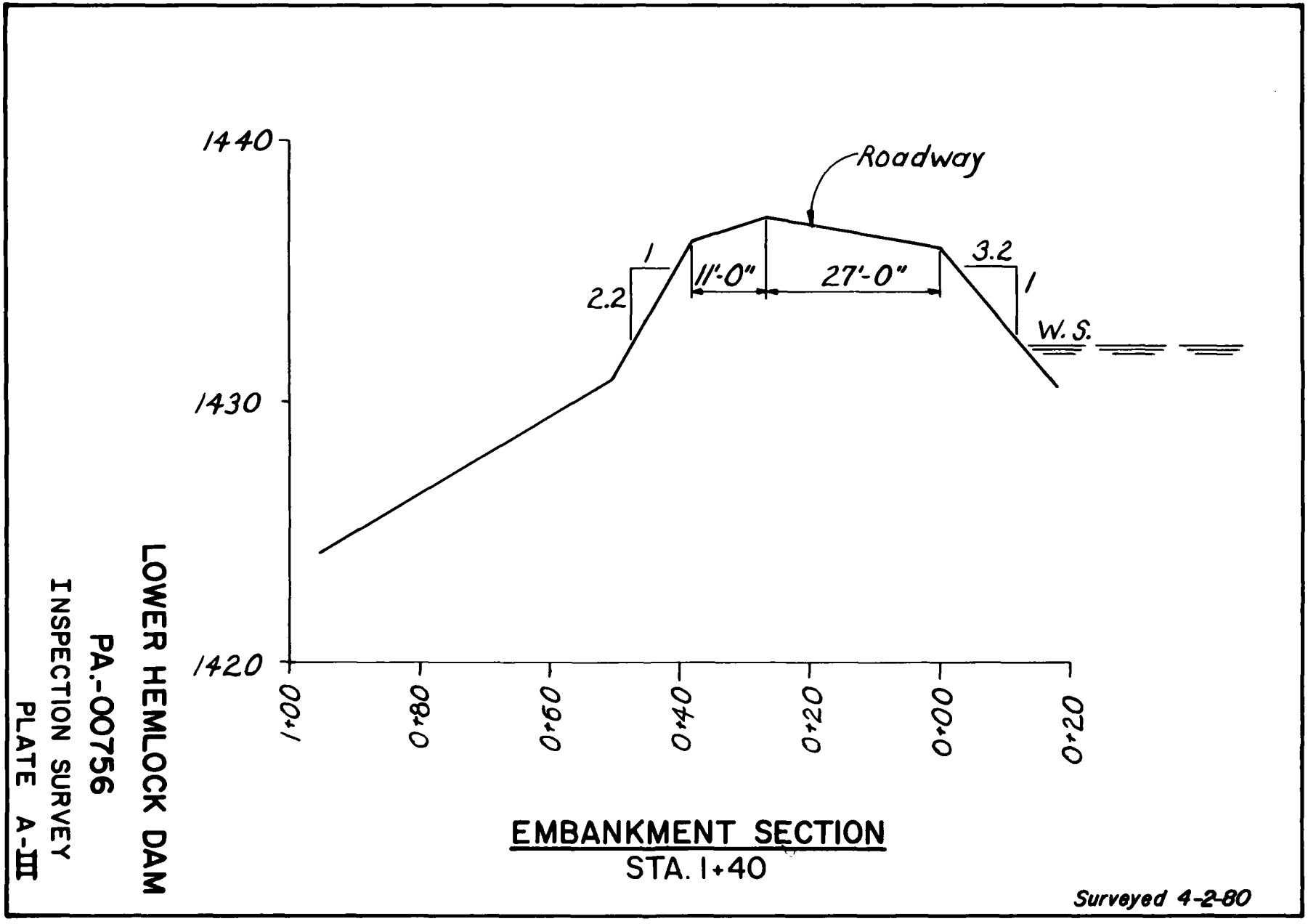


LOWER HEMLOCK DAM

PA.-00756

INSPECTION SURVEY

PLATE A-II



LOWER HEMLOCK DAM

PA.-00756

INSPECTION SURVEY

PLATE A-III

EMBANKMENT SECTION

STA. 1+40

Surveyed 4-2-80

APPENDIX B

CHECKLIST OF ENGINEERING DATA

CHECK LIST
ENGINEERING DATA

PA DER # 52-117 NDI NO. PA-00 756

NAME OF DAM LOWER HEMLOCK DAM

ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. Quadrangle - Pecks Pond, Pa. See Plate II, Appendix E
CONSTRUCTION HISTORY	No records.
GENERAL PLAN OF DAM	Plate III, Appendix E.
TYPICAL SECTIONS OF DAM	Plate IV, Appendix E.
OUTLETS: PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	Plates IV & V, Appendix E. Bridge over spillway. No ratings.

NDI NO. PA-00 756

ENGINEERING DATA

ITEM	REMARKS
RAINFALL & RESERVOIR RECORDS	No records.
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS: HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS: BORING RECORDS LABORATORY FIELD	No records.
POST CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.

ENGINEERING DATA

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	The valve chamber has been changed from what is shown on Plate IV. The chamber is located near the upstream toe, smaller in size with a large platform which is connected with a bridge to the dam crest.
HIGH POOL RECORDS	No records.
POST CONSTRUCTION ENGINEERING STUDIES & REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM *Description:* Reports:	None reported.
MAINTENANCE & OPERATION RECORDS	No records.
SPILLWAY PLAN, SECTIONS AND DETAILS	Plate V, Appendix E.

NDI NO. PA-00 756

ENGINEERING DATA

ITEM	REMARKS
OPERATING EQUIPMENT, PLANS & DETAILS	Plate IV, Appendix E.
CONSTRUCTION RECORDS	No records.
PREVIOUS INSPECTION REPORTS & DEFICIENCIES	No deficiencies reported.
MISCELLANEOUS	

NDI NO. PA-00 756

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: wooded, vacation housing development

ELEVATION:

TOP NORMAL POOL & STORAGE CAPACITY: Elev. 1432 Acre-Feet 307

TOP FLOOD CONTROL POOL & STORAGE CAPACITY: Elev. 1435.3 Acre-Feet 394

MAXIMUM DESIGN POOL: Elev. 1435.3

TOP DAM: Elev. 1435.3

SPILLWAY:

a. Elevation 1432

b. Type concrete ogee with fish screen

c. Width 47' with two 21" piers

d. Length --

e. Location Spillover near center of dam

f. Number and Type of Gates none

OUTLET WORKS:

a. Type 24" pipe

b. Location near right abutment

c. Entrance inverts 1421.5

d. Exit inverts 1419

e. Emergency drawdown facilities 24" pipe

HYDROMETEOROLOGICAL GAGES:

a. Type none

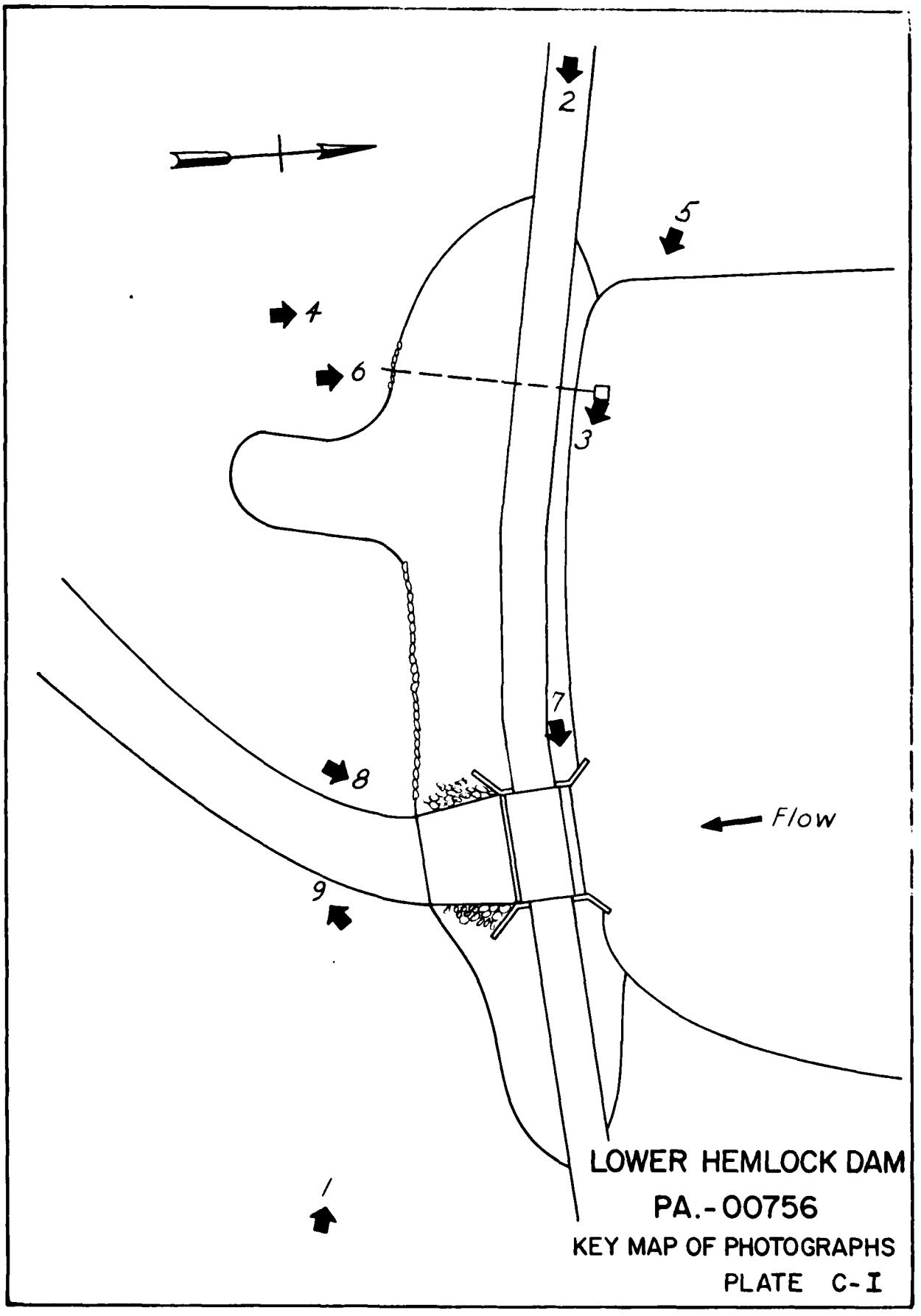
b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 1012 cfs

APPENDIX C

PHOTOGRAPHS


2
5
4
6
3
7
8
Flow
9
1
LOWER HEMLOCK DAM
PA.-00756
KEY MAP OF PHOTOGRAPHS
PLATE C-I

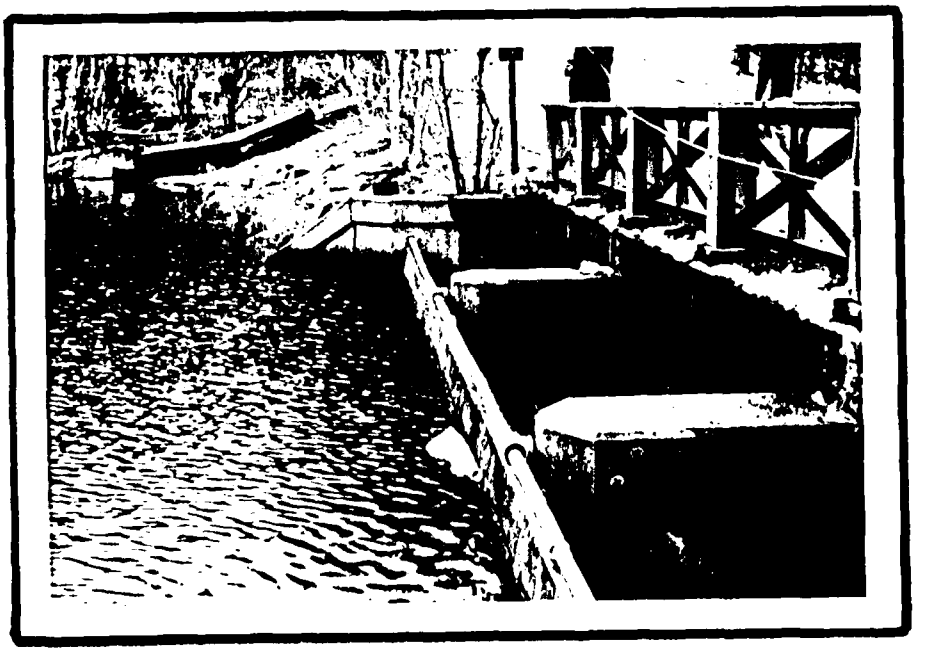
OVERVIEW FROM RIGHT ABUTMENT - NO. 2

UPSTREAM SLOPE - NO. 3
NOTE TREES

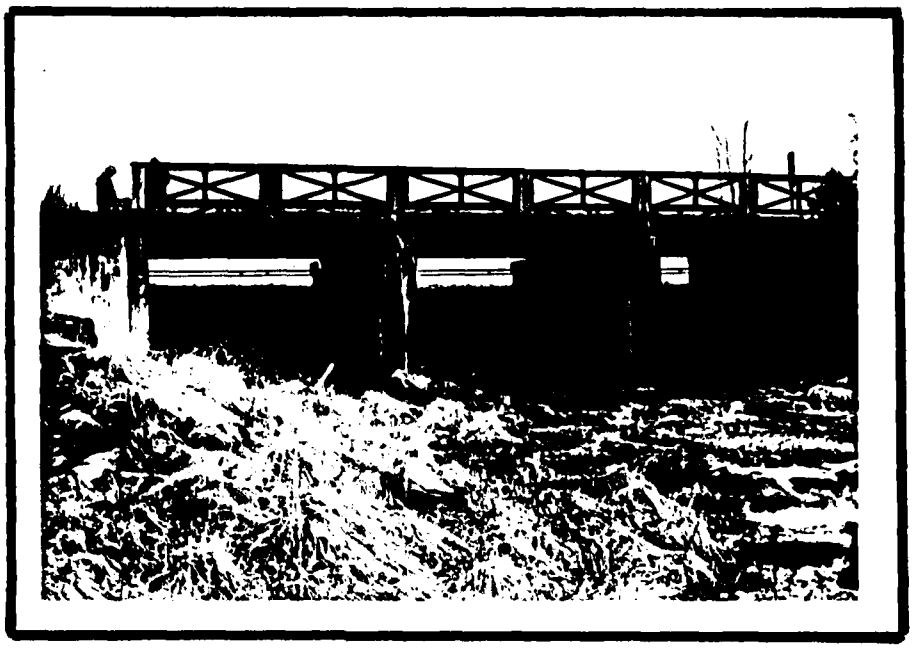
VOIDS IN SPOIL AREA - NO. 4

VALVE CHAMBER - NO. 5

OUTLET PIPE & STONE WALL - NO. 6



SPILLWAY WEIR AND FISH GUARD - NO. 7



SPILLWAY AND BRIDGE LOOKING UPSTREAM - NO. 8

DOWNSTREAM CHANNEL - NO. 9

PA-00756
Plate C-V

APPENDIX D

HYDROLOGY AND HYDRAULIC CALCULATIONS

SUMMARY DESCRIPTION
OF
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION

The hydrologic and hydraulic evaluation for this inspection report has employed computer techniques using the Corps of Engineers computer program identified as the Flood Hydrograph Package (HEC-1) Dam Safety Version.

The program has been designed to enable the user to perform two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam, and (2) the capability to estimate the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. A brief summary of the computation procedures typically used in the dam overtopping analysis is shown below.

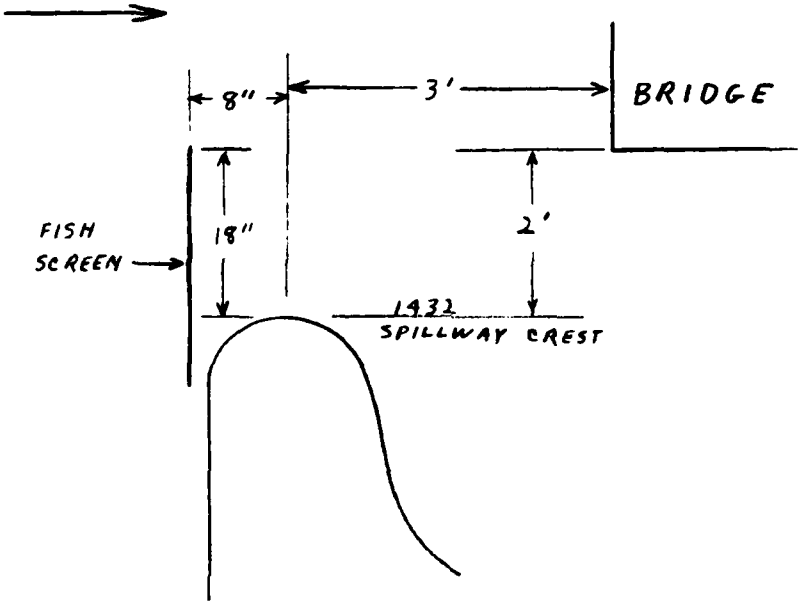
- Development of an inflow hydrograph to the reservoir.
- Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.
- Routing of the outflow hydrograph(s) of the reservoir to desired downstream locations. The results provide the peak discharge and maximum stage of each routed hydrograph at the outlet of the reach.

The output data provided by this program permits the comparison of downstream conditions just prior to a breach failure with that after a breach failure and the determination as to whether or not there is a significant increase in the hazard to loss of life as a result of such a failure.

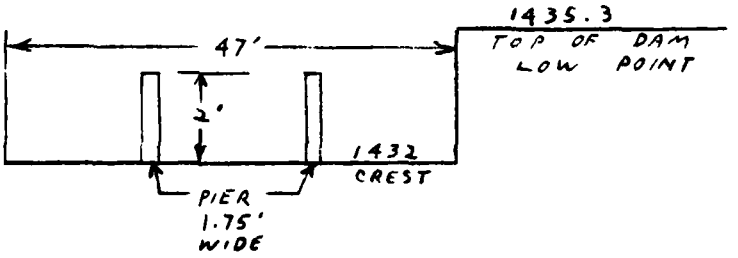
The results of the studies conducted for this report are presented in Section 5.

For detailed information regarding this program refer to the Users Manual for the Flood Hydrograph Package (HEC-1) Dam Safety Version prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

SPILLWAY RATING



OGEE SECTION C = 3.88 (SMALL DAMS)



$Q = C\ L\ H^{3/2}$

$L = 47 - 2(1.75) = 43.5'$

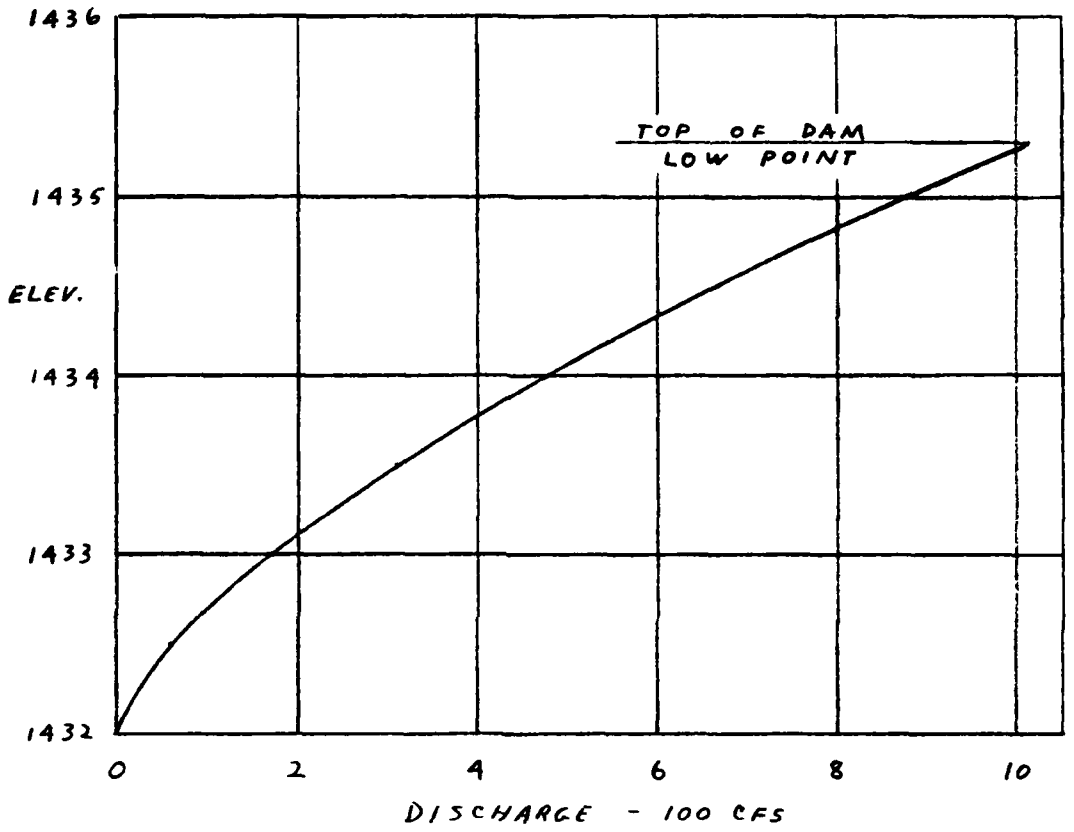
$H = 1435.3 - 1432 = 3.3'$

$Q = 3.88 \times 43.5 \times (3.3)^{1.5}$

$= 1012$ CFS

BY RLS DATE 5/14/80 **BERGER ASSOCIATES** SHEET NO. 2 OF 6
CHKD. BY DATE PROJECT D 9650
SUBJECT LOWER HEMLOCK

SPILLWAY RATING CURVE (UNOBSTRUCTED)



BY RLS DATE 5/14/80 **BERGER ASSOCIATES** SHEET NO. 3 OF 6
CHKD. BY DATE PROJECT 09650
SUBJECT LOWER HEMLOCK

DISCHARGE THROUGH OUTLET WORKS

24" DIAMETER PIPE INTO DISCHARGE CHAMBER

INVERT ELEV. = 1421.5

$Q = C A \sqrt{2gH}$ $C = 0.6$

AT POOL ELEV. 1432

$H = 1432 - 1422.5 = 9.5$

$Q = 0.6 \times \pi \times (2)^2/4 \times (2 \times 32.2 \times 9.5)^{0.5}$

$= 47$ CFS

AT LOW POOL ELEV 1425

$H = 1425 - 1422.5 = 2.5$

$Q = 0.6 \times \pi \times (2)^2/4 \times (2 \times 32.2 \times 2.5)^{0.5}$

$= 24$ CFS

BY RLS DATE 5/16/80 **BERGER ASSOCIATES** SHEET NO. 4 OF 6
CHKD. BY DATE PROJECT 09650
SUBJECT LOWER HEMLOCK

EMBANKMENT RATING

$Q = C L H^{3/2}$ $C = 2.7$ (KINGS HDBK.)

AT ELEV. 1435.5

$2.7 \times 28 \times (.1)^{1.5} = 2$
$2.7 \times 25 \times (.15)^{1.5} = 4$
$2.7 \times 6 \times (.05)^{1.5} = -$ $\Sigma = 6$ CFS

AT ELEV. 1436

$2.7 \times 28 \times (.6)^{1.5} = 35$
$2.7 \times 25 \times (.65)^{1.5} = 35$
$2.7 \times 33 \times (.3)^{1.5} = 15$
$2.7 \times 25 \times (.2)^{1.5} = 6$ $\Sigma = 91$ CFS

AT ELEV. 1436.5

$2.7 \times 28 \times (1.1)^{1.5} = 87$
$2.7 \times 25 \times (1.15)^{1.5} = 83$
$2.7 \times 50 \times (.65)^{1.5} = 71$
$2.7 \times 25 \times (.7)^{1.5} = 40$
$2.7 \times 8 \times (.1)^{1.5} = 1$
$2.7 \times 9 \times (.25)^{1.5} = 3$ $\Sigma = 285$ CFS

AT ELEV. 1437

$2.7 \times 28 \times (1.6)^{1.5} = 153$
$2.7 \times 25 \times (1.65)^{1.5} = 143$
$2.7 \times 50 \times (1.15)^{1.5} = 166$
$2.7 \times 25 \times (1.2)^{1.5} = 89$
$2.7 \times 29 \times (.35)^{1.5} = 16$
$2.7 \times 18 \times (.5)^{1.5} = 17$ $\Sigma = 584$ CFS

AT ELEV 1438

$2.7 \times 28 \times (2.6)^{1.5} = 317$
$2.7 \times 25 \times (2.65)^{1.5} = 291$
$2.7 \times 50 \times (2.15)^{1.5} = 426$
$2.7 \times 25 \times (2.2)^{1.5} = 220$
$2.7 \times 50 \times (1.1)^{1.5} = 156$
$2.7 \times 13 \times (.25)^{1.5} = 4$
$2.7 \times 36 \times (1)^{1.5} = 97$ $\Sigma = 1511$ CFS

MAXIMUM KNOWN FLOOD AT DAMSITE

THERE ARE NO RECORDS OF POOL LEVELS FOR THIS DAM. BASED ON THE RECORDS OF THE GAGING STATION FOR MILL CREEK AT NEARBY MOUNTAINHOME, PA. (D.A. = 5.84 SQ. MI.) THE MAXIMUM DISCHARGE AT THE GAGE OCCURRED IN JULY 1969 WHEN A DISCHARGE OF 1650 CFS WAS OBSERVED. THE MAXIMUM INFLOW TO LOWER HEMLOCK LAKE IS ESTIMATED TO BE:

$$Q = \left(\frac{1.36}{5.84}\right)^{0.8} \times 1650$$

$$= 514 \text{ CFS}$$

DESIGN FLOOD

SIZE CLASSIFICATION

MAXIMUM STORAGE = 394 ACRE-FEET
MAXIMUM HEIGHT = 15 FEET
SIZE CLASSIFICATION IS "SMALL"

HAZARD CLASSIFICATION

BLUE HERON LAKE DAM AND SEVERAL HOUSES ARE LOCATED ALONG THE DOWNSTREAM CHANNEL.
USE "HIGH"

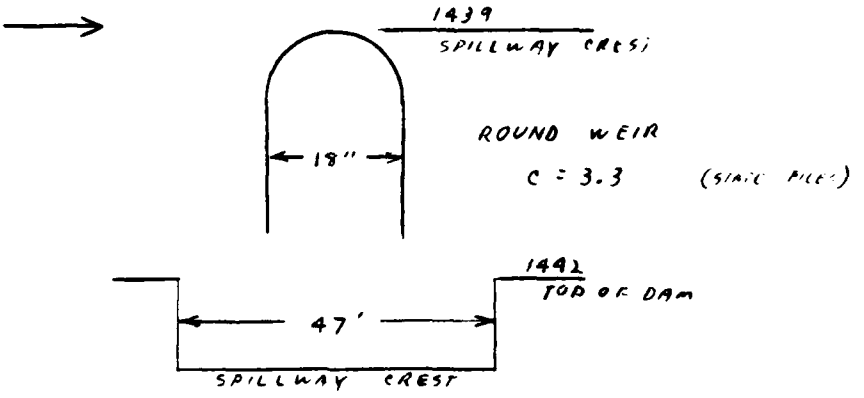
RECOMMENDED SPILLWAY DESIGN FLOOD

THE ABOVE CLASSIFICATIONS INDICATE USE OF AN SDF EQUAL TO ONE-HALF PMF TO THE PROBABLE MAXIMUM FLOOD.

BY RLS DATE 6/11/80 **BERGER ASSOCIATES** SHEET NO. 5A OF
CHKD. BY DATE PROJECT D965C
SUBJECT LOWER HEMLOCK

UPSTREAM RESERVOIR

UPPER HEMLOCK DAM



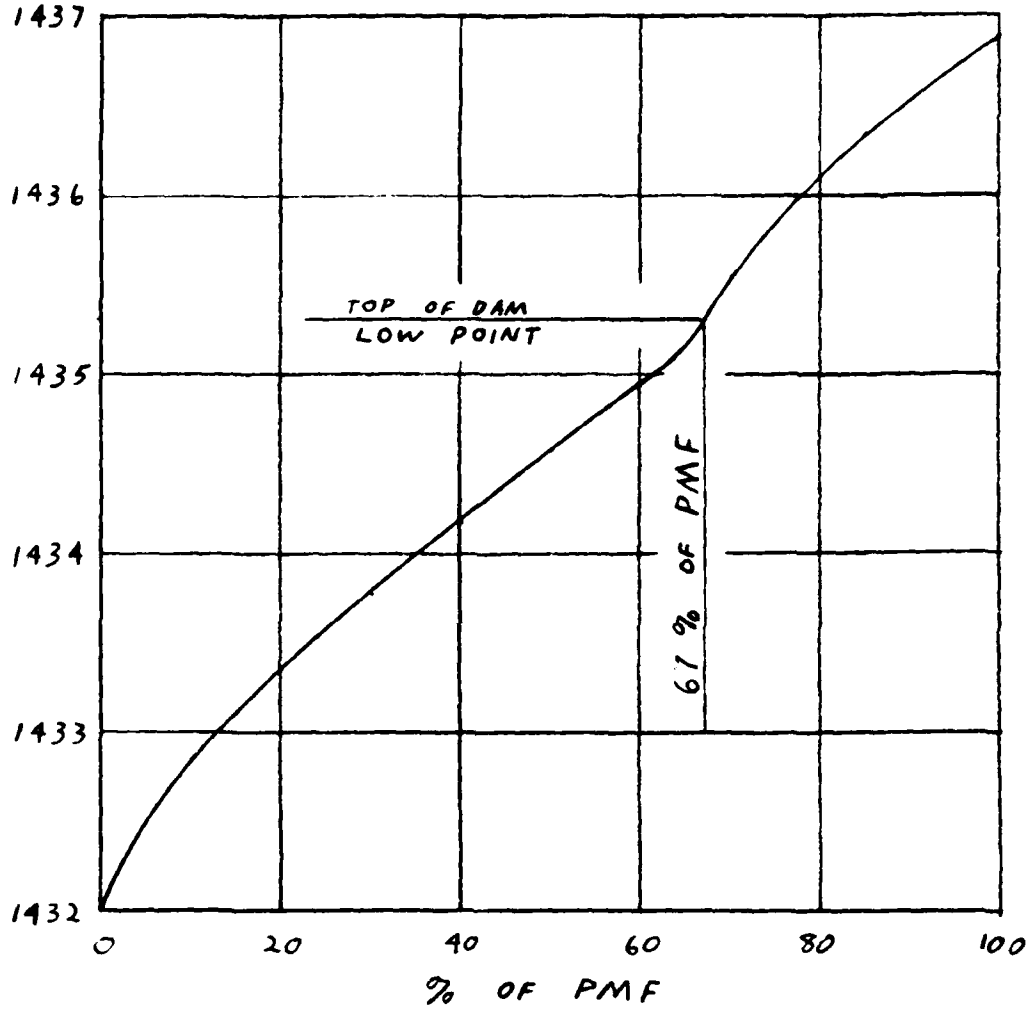
EMBANKMENT 450' LONG 150' IDAHIDIN C = 2.6

STAGE	STORAGE
1428 'MSL	0 A-F
1439 "	918 "
1440 "	1044 "
1460 "	4594 "

DATA FROM STATE FILES

BY RLS DATE 5/19/80 **BERGER ASSOCIATES** SHEET NO. 6 OF 6
CHKD. BY DATE PROJECT D9650
SUBJECT LOWER HEMLOCK

SPILLWAY CAPACITY CURVE



HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: LOWER HEMLOCK RIVER BASIN: DELAWARE

PROBABLE MAXIMUM PRECIPITATION (PMP) = 21.6 INCHES/24 HOURS[1]

(FOR FOOTNOTES SEE NEXT PAGE)

STATION		1	2	3	4
STATION DESCRIPTION		HEMLOCK LAKE	HEMLOCK LAKE DAM	LOWER HEMLOCK LAKE	LOWER HEMLOCK DAM
DRAINAGE AREA (SQUARE MILES)		1.19	-	.17	-
CUMULATIVE DRAINAGE AREA (SQUARE MILE)		1.19	1.19	1.36	1.36
ADJUSTMENT OF PMP FOR DRAINAGE AREA (%)[2]	6 HOURS	111		111	
	12 HOURS	123		123	
	24 HOURS	133		133	
	48 HOURS	142		142	
	72 HOURS	-		-	
	Zone 1				
SNYDER HYDROGRAPH PARAMETERS	ZONE[3]	1		1	
	C_p / C_t[4]	.45/1.23		.45/1.23	
	L (MILES)[5]	$L^1 = .83$		$L^1 = .27$	
	L_{ca} (MILES)[5]				
	$T_p = C_t (L \cdot L_{ca})^{0.3}$ (hours)	$C_t (L^1) \cdot 6 =$ 1.10		$C_t (L^1) \cdot 6 =$ .56	
SPILLWAY DATA	CREST LENGTH (FT.)		47		43.5
	FREEBOARD (FT.)		3		3.3
	DISCHARGE COEFFICIENT		3.3		3.88
	EXPONENT		1.5		1.5
	ELEVATION		1439		1432
AREA[6] (ACRES)	NORMAL POOL			23.1	
	ELEV. _____			1440 = 39.7	
	ELEV. _____				
STORAGE (ACRE-FEET)	NORMAL POOL[7]	918		307	
	ELEV. _____[8]	1428 = 0		1392.1 = 0	
	ELEV. _____[8]	1440 = 1044			
	ELEV _____[8]	1460 = 4594			

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

(2) Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

(3) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

(4) Snyder's Coefficients.

(5) L = Length of longest water course from outlet to basin divide.
L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

(6) Planimetered area encompased by contour upstream of dam.

(7) PennDER files.

(8) Computed by conic method.

```
 LAST MODIFICATION  26 FEB 79
**********************************
   1              A1                    LOWER HEMLOCK DAM    ****    TRIB TO ROCK HILL CREEK
   2              A2                    BLOOMING GROVE TWP., PIKE COUNTY, PA.
   3              A3                    NDI # PA-00756        PA DER #  52-117
   4              B   300       0      15       0       0       0       0       0      -4       0
   5              B1    5
   6              J     1       9       1
   7              J1    1     .85      .7      .6      .5      .4      .3      .2      .1
   8              K             1                                               1
   9              K1                    INFLOW HYDROGRAPH - HEMLOCK DAM SUBAREA
  10              M     1       1    1.19            1.36
  11              P           21.6     111     123     133     142
  12              T                                                       1     .05
  13              W  1.10     .45
  14              X  -1.5    -.05       2
  15              K     1       2                                         1
  16              K1                    RESERVOIR ROUTING - HEMLOCK DAM
  17              Y                             1
  18              Y1    1                                                 918
  19              $S    0     918    1004    4594
  20              $E 1428    1439    1440    1460
  21              $$ 1439      47     3.3     1.5
  22              $D 1442     2.6     1.5     450
  23              K             3                                         1
  24              K1                    INFLOW HYDROGRAPH - LOWER HEMLOCK SUBAREA
  25              M     1       1     .17            1.36
  26              P           21.6     111     123     133     142
  27              T                                                       1     .05
  28              W   .56     .45
  29              X  -1.5    -.05       2
  30              K     2       4                                         1
  31              K1                    COMBINE HYDROGRAPHS
  32              K     1       5                                         1
  33              K1                    RESERVOIR ROUTING - LOWER HEMLOCK DAM
  34              Y                             1
  35              Y1    1                                                 307     -1
  36              Y4 1432  1432.5    1433  1433.5    1434  1434.5    1435  1435.3    1436  1436.5
  37              Y4 1437    1438
  38              Y5    0      60     169     310     477     667     877    1012    1441    1896
  39              Y5 2471    3992
  40              $A    0    23.1    39.7
  41              $E1392.1   1432    1440
  42              $$ 1432
  43              $D1435.3
  44              K    99
1                                   PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                      RUNOFF HYDROGRAPH AT          1
                                      ROUTE HYDROGRAPH TO           2
                                      RUNOFF HYDROGRAPH AT          3
                                      COMBINE  2 HYDROGRAPHS AT     4
                                      ROUTE HYDROGRAPH TO           5
                                      END OF NETWORK

1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION     JULY 1978
   LAST MODIFICATION  26 FEB 79
 **********************************
```

LOWER HEMLOCK DAM **** TRIB TO ROCK HILL CREEK
BLOOMING GROVE TWP., PIKE COUNTY, PA.
NDI # PA-00756 PA DER # 52-117

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1
RTIOS= 1.00 .85 .70 .60 .50 .40 .30 .20 .10

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH ~ HEMLOCK DAM SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.19	0.00	1.36	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.60	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.10 CP= .45 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 40 END-OF-PERIOD ORDINATES, LAG= 1.10 HOURS, CP= .45 VOL= 1.00

29.	106.	205.	285.	309.	283.	246.	213.	185.	160.
139.	121.	105.	91.	79.	68.	59.	51.	45.	39.
34.	29.	25.	22.	19.	16.	14.	12.	11.	9.
8.	7.	6.	5.	5.	4.	3.	3.	3.	2.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.54	22.15	2.39	69018.
										(623.)(563.)(61.)(1954.37)			

---------- ---------- ---------- ---------- ----------

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING - HEMLOCK DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	918.	0

CAPACITY=	0.	918.	1004.	4594.
ELEVATION=	1428.	1439.	1440.	1460.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1439.0	47.0	3.3	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1442.0	2.6	1.5	450.

PEAK OUTFLOW IS 2158. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 1650. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 1126. AT TIME 43.25 HOURS

PEAK OUTFLOW IS 805. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 654. AT TIME 43.75 HOURS

PEAK OUTFLOW IS 510. AT TIME 43.75 HOURS

PEAK OUTFLOW IS 375. AT TIME 43.75 HOURS

PEAK OUTFLOW IS 251. AT TIME 43.75 HOURS

PEAK OUTFLOW IS 136. AT TIME 43.50 HOURS

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - LOWER HEMLOCK SUBAREA

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - LOWER HEMLOCK SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.17	0.00	1.36	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.60	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= .56 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 21 END-OF-PERIOD ORDINATES, LAG= .56 HOURS, CP= .45 VOL= 1.00

23.	68.	82.	64.	49.	37.	28.	21.	16.	12.
9.	7.	5.	4.	3.	2.	2.	1.	1.	1.
1.									

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.54	22.15	2.39	9853.
										(623.)	(563.)	(61.)	(279.01)

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	2	0	0	0	0	1	0	0

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING - LOWER HEMLOCK DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO

HYDROGRAPH ROUTING

RESERVOIR ROUTING - LOWER HEMLOCK DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	307.	-1

STAGE	1432.00	1432.50	1433.00	1433.50	1434.00	1434.50	1435.00	1435.30	1436.00	1436.50
	1437.00	1438.00								
FLOW	0.00	60.00	169.00	310.00	477.00	667.00	877.00	1012.00	1441.00	1896.00
	2471.00	3992.00								
SURFACE AREA=	0.	23.	40.							
CAPACITY=	0.	307.	555.							
ELEVATION=	1392.	1432.	1440.							

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1432.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1435.3	0.0	0.0	0.

PEAK OUTFLOW IS 2333. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 1740. AT TIME 43.00 HOURS

PEAK OUTFLOW IS 1161. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 855. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 695. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 543. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 399. AT TIME 43.50 HOURS

PE JTFLOW IS 267. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 136. AT TIME 44.50 HOURS

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .85	RATIO 3 .70	RATIO 4 .60	RATIO 5 .50	RATIO 6 .40	RATIO 7 .30	RATIO 8 .20	RATIO 9 .10
HYDROGRAPH AT	1	1.19	1	3193.	2714.	2235.	1916.	1597.	1277.	958.	639.	319.
	(	3.08)	(	90.42)(	76.85)(	63.29)(	54.25)(	45.21)(	36.17)(	27.12)(	18.08)(	9.04)
ROUTED TO	2	1.19	1	2158.	1650.	1126.	805.	654.	510.	375.	251.	136.
	(	3.08)	(	61.11)(	46.73)(	31.89)(	22.80)(	18.52)(	14.44)(	10.62)(	7.11)(	3.84)
HYDROGRAPH AT	3	.17	1	642.	546.	449.	385.	321.	257.	193.	128.	64.
	(	.44)	(	18.18)(	15.46)(	12.73)(	10.91)(	9.09)(	7.27)(	5.45)(	3.64)(	1.82)
2 COMBINED	4	1.36	1	2388.	1803.	1209.	885.	721.	565.	419.	284.	149.
	(	3.52)	(	67.63)(	51.06)(	34.24)(	25.07)(	20.42)(	16.00)(	11.86)(	8.04)(	4.23)
ROUTED TO	5	1.36	1	2333.	1740.	1161.	855.	695.	543.	399.	267.	136.
	(	3.52)	(	66.06)(	49.26)(	32.88)(	24.21)(	19.69)(	15.37)(	11.31)(	7.55)(	3.86)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1439.00	1439.00	1442.00
STORAGE	918.	918.	1363.
OUTFLOW	0.	0.	806.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1442.88	.88	1522.	2158.	5.75	42.50	0.00
.85	1442.63	.63	1475.	1650.	5.00	42.75	0.00
.70	1442.30	.30	1417.	1126.	3.50	43.25	0.00
.60	1442.00	0.00	1363.	805.	0.00	43.50	0.00
.50	1441.61	0.00	1293.	654.	0.00	43.75	0.00
.40	1441.21	0.00	1221.	510.	0.00	43.75	0.00
.30	1440.80	0.00	1148.	375.	0.00	43.75	0.00
.20	1440.38	0.00	1072.	251.	0.00	43.75	0.00
.10	1439.91	0.00	997.	136.	0.00	43.50	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1431.97	1432.00	1435.30
STORAGE	307.	307.	394.
OUTFLOW	0.	0.	1012.

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1431.97	1432.00	1435.30
STORAGE	307.	307.	394.
OUTFLOW	0.	0.	1012.

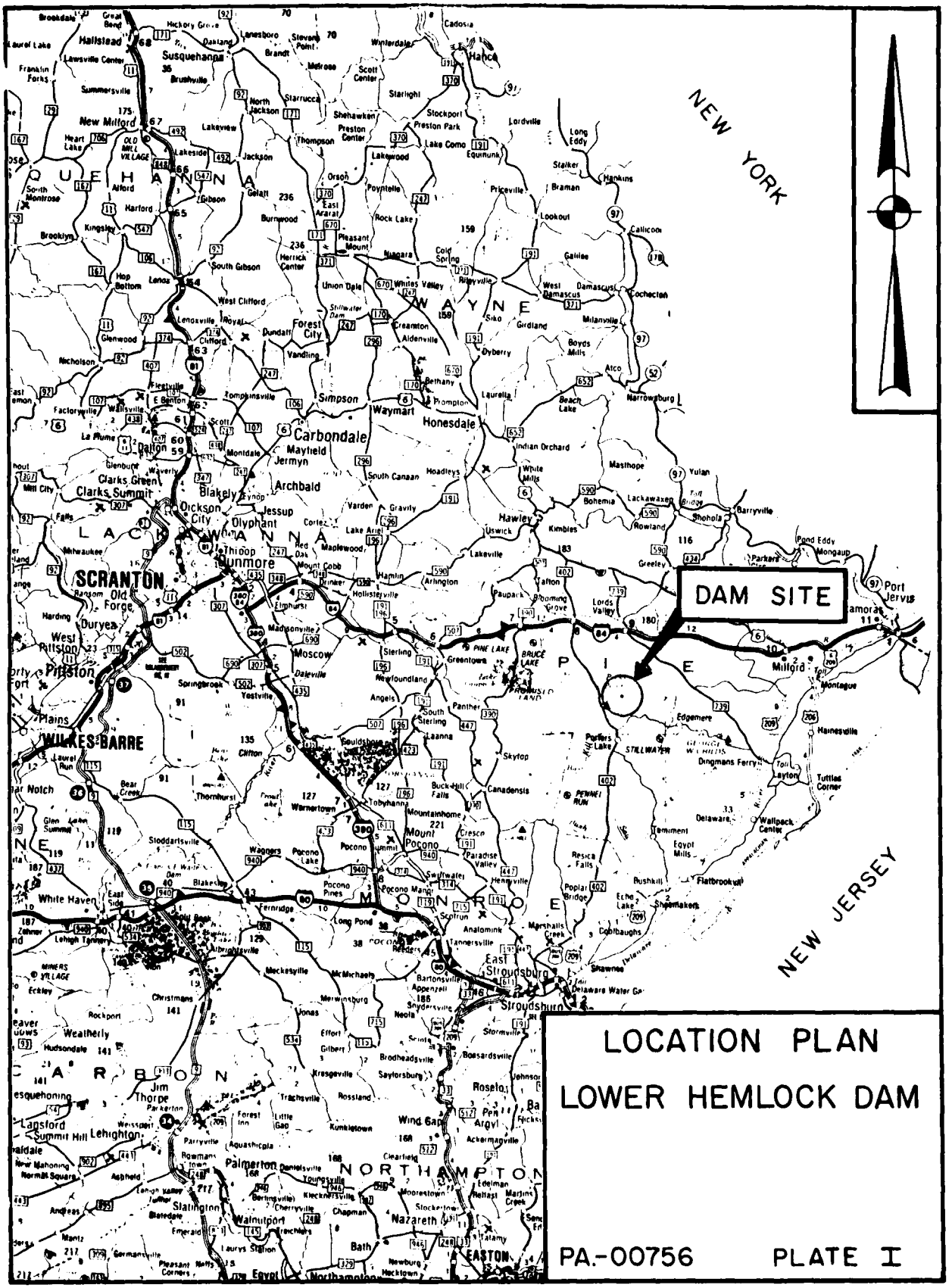
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1436.88	1.58	443.	2333.	5.75	42.75	0.00
.85	1436.33	1.03	425.	1740.	4.50	43.00	0.00
.70	1435.54	.24	401.	1161.	2.25	43.50	0.00
.60	1434.95	0.00	383.	855.	0.00	43.50	0.00
.50	1434.57	0.00	373.	695.	0.00	43.50	0.00
.40	1434.17	0.00	362.	543.	0.00	43.50	0.00
.30	1433.77	0.00	351.	399.	0.00	43.50	0.00
.20	1433.35	0.00	340.	267.	0.00	43.50	0.00
.10	1432.85	0.00	328.	136.	0.00	44.50	0.00

EOI ENCOUNTERED.

N>

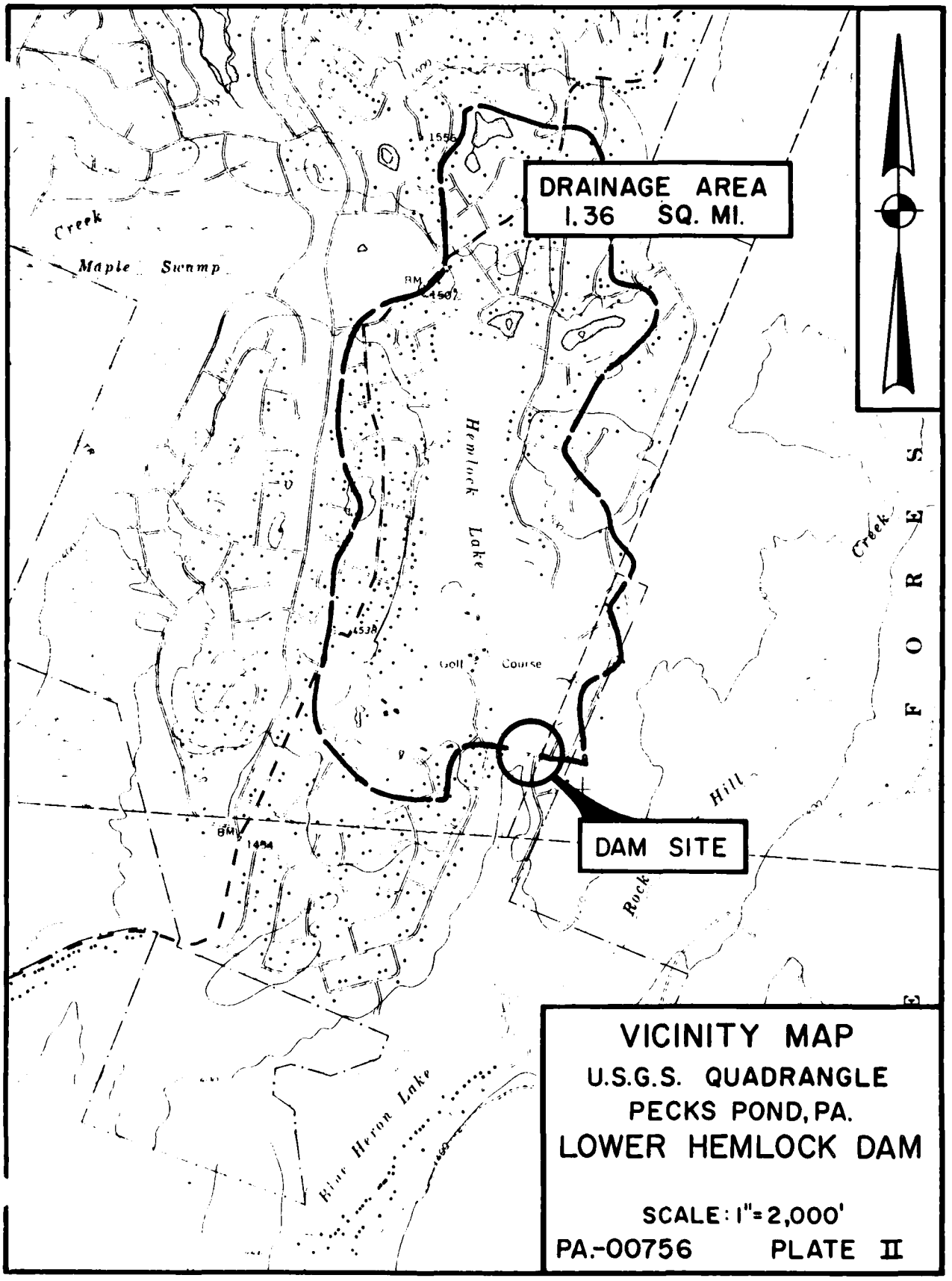
APPENDIX E

PLATES



LOCATION PLAN
LOWER HEMLOCK DAM

PA.-00756 PLATE I



VICINITY MAP

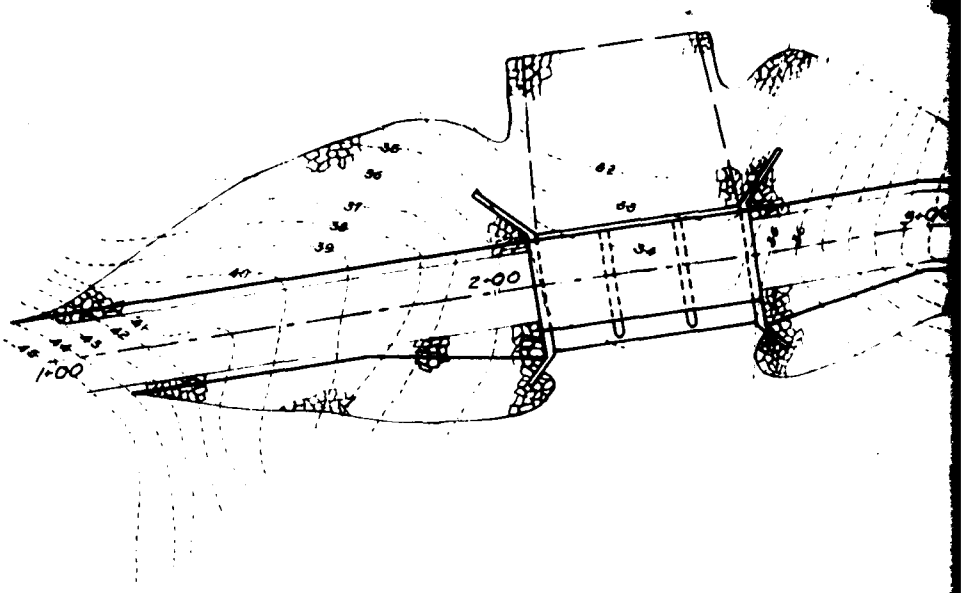
U.S.G.S. QUADRANGLE

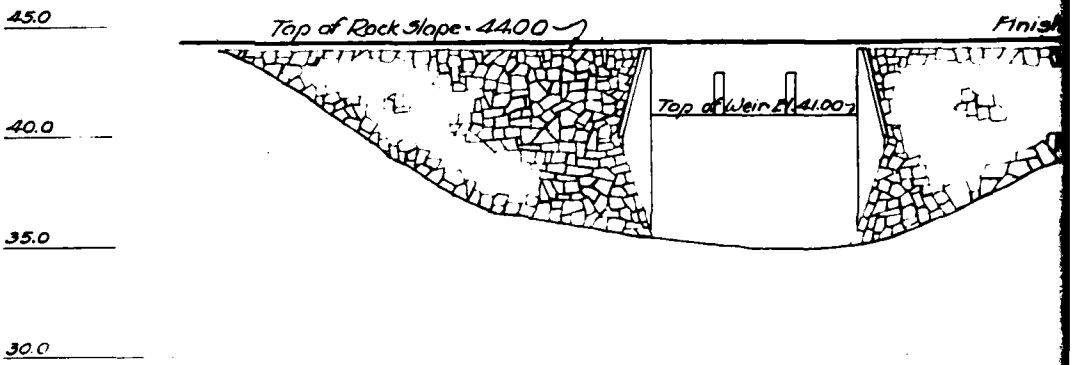
PECKS POND, PA.

LOWER HEMLOCK DAM

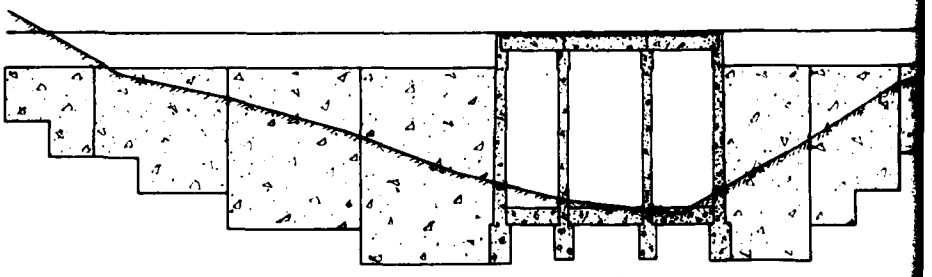
SCALE: 1"= 2,000'

PA.-00756 PLATE II

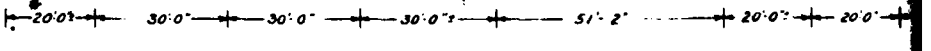




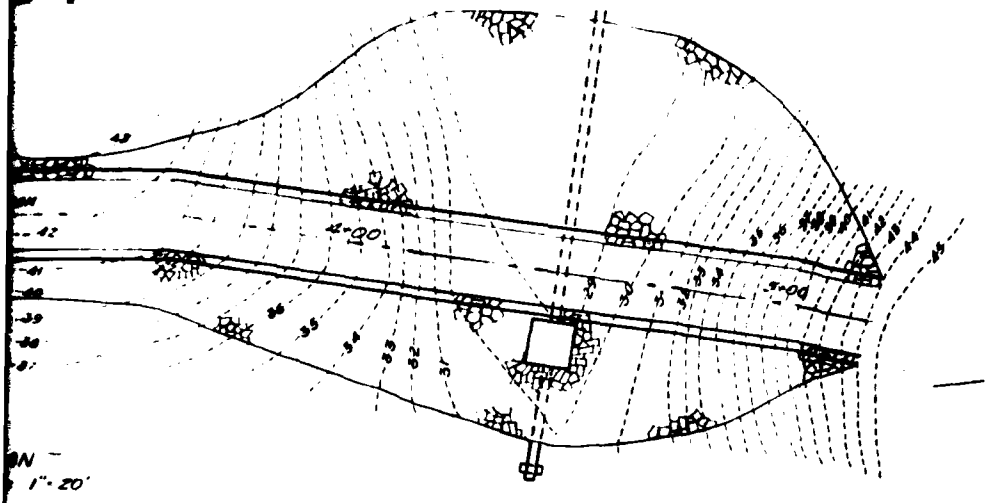
UPSTREAM



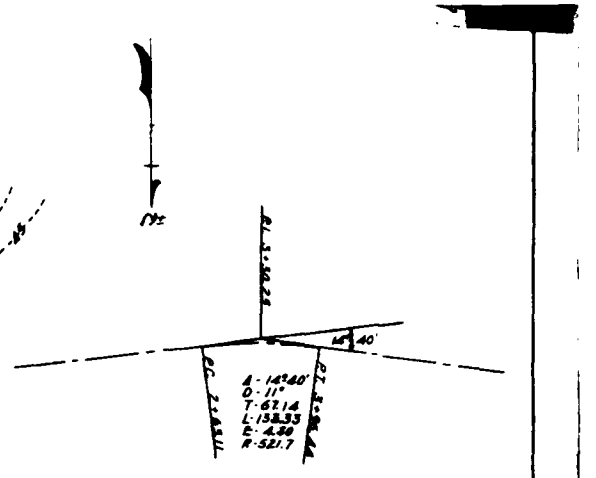
* See Note on Sheet 3



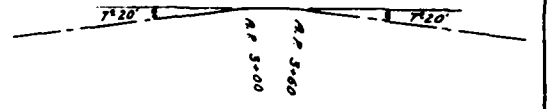
Depth of Core Wall to be determined in field as per Note on Sheet 3.



N –
1" = 20'

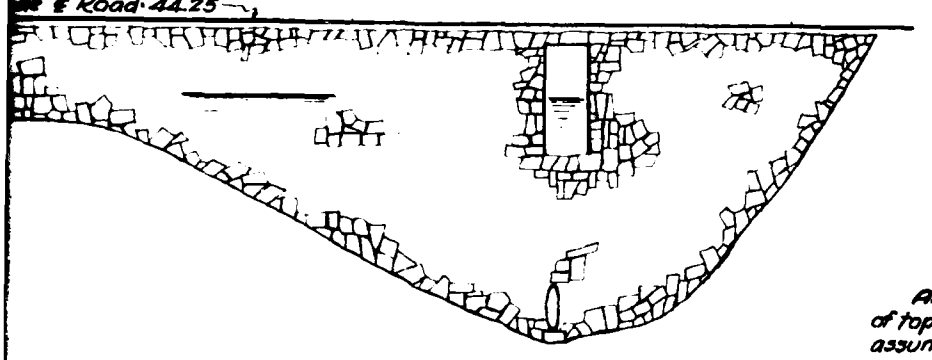


– ALIGNMENT FOR ROADWAY AND FILL LIMITS –



– ALIGNMENT FOR CORE WALL AND IMPERVIOUS FILL –

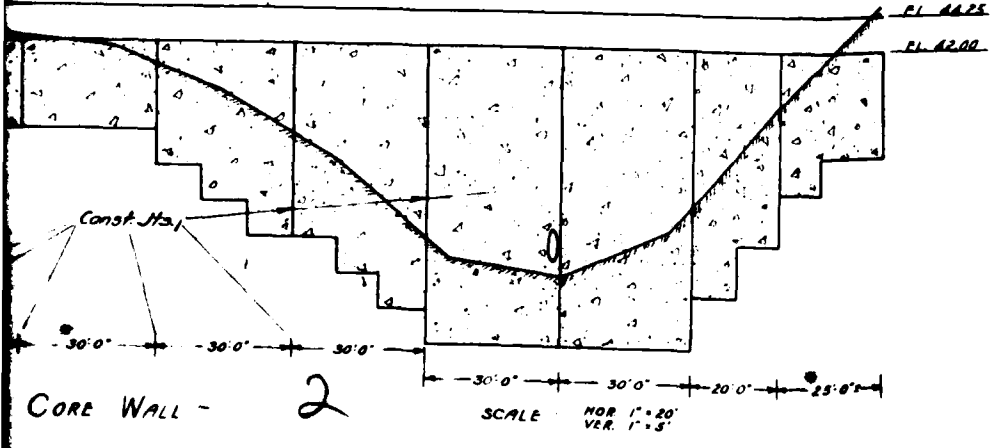
SCALE : 1" = 100'



TION OF DAM
= 1"=20'
= 1" = 4'

All datum hereon is based on elevation of top of existing weir of Lake Hemlock with an assumed elevation of 50.00

All work incorporated in these plans is restricted to the approximate limits of Station 1+00 to Station 5+25.

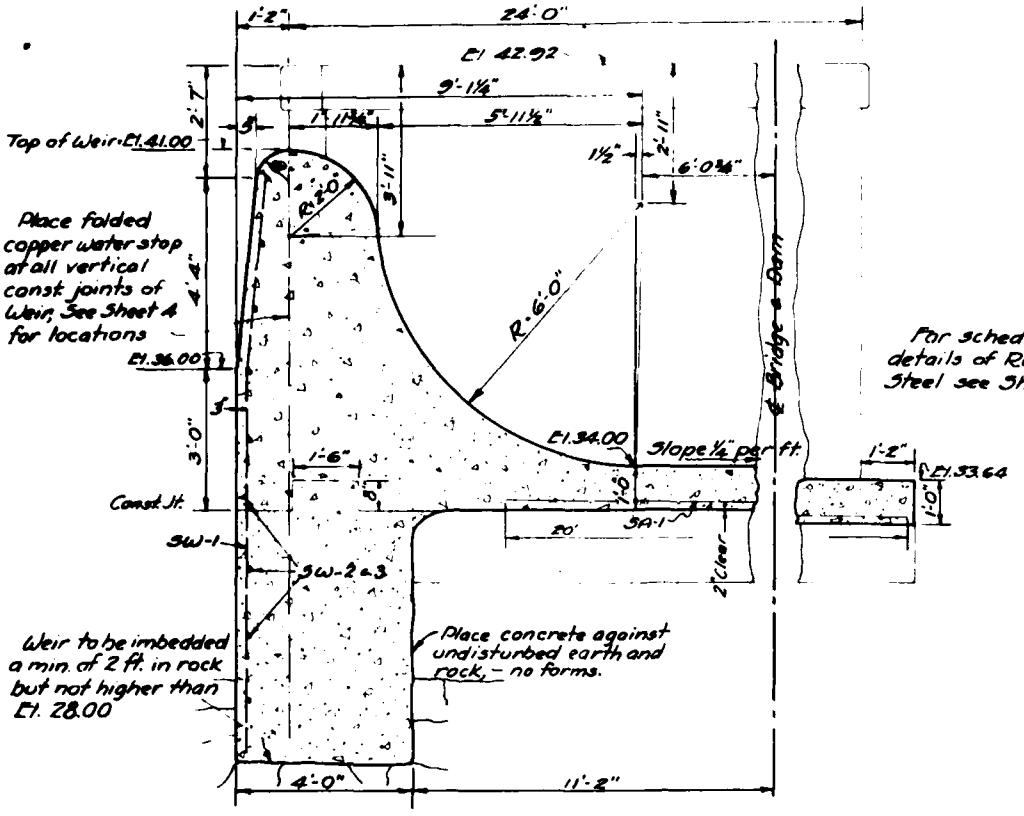


CORE WALL – 2

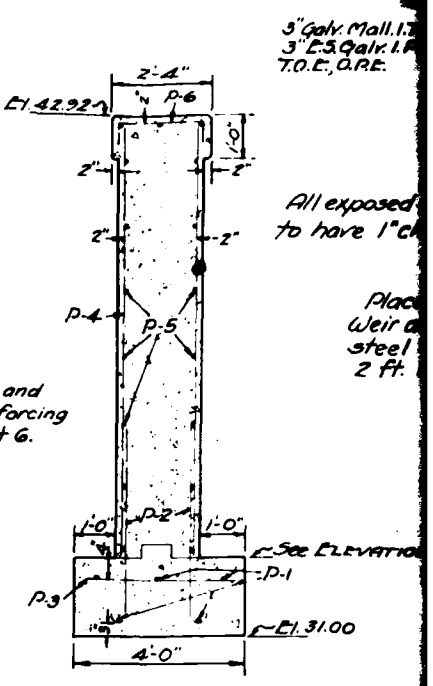
SCALE HOR 1" = 20'
VER. 1" = 5'

HEMLOCK FARMS, INC. LORDS VALLEY, PA.
LOWER LAKE DAM
DAM PLAN – DAM ELEVATION, CORE WALL PROFILE
GEO. M. BREWSTER & SON, INC. ENGINEERING DEPARTMENT APRIL – 1945
SHEET No. 2 of 8

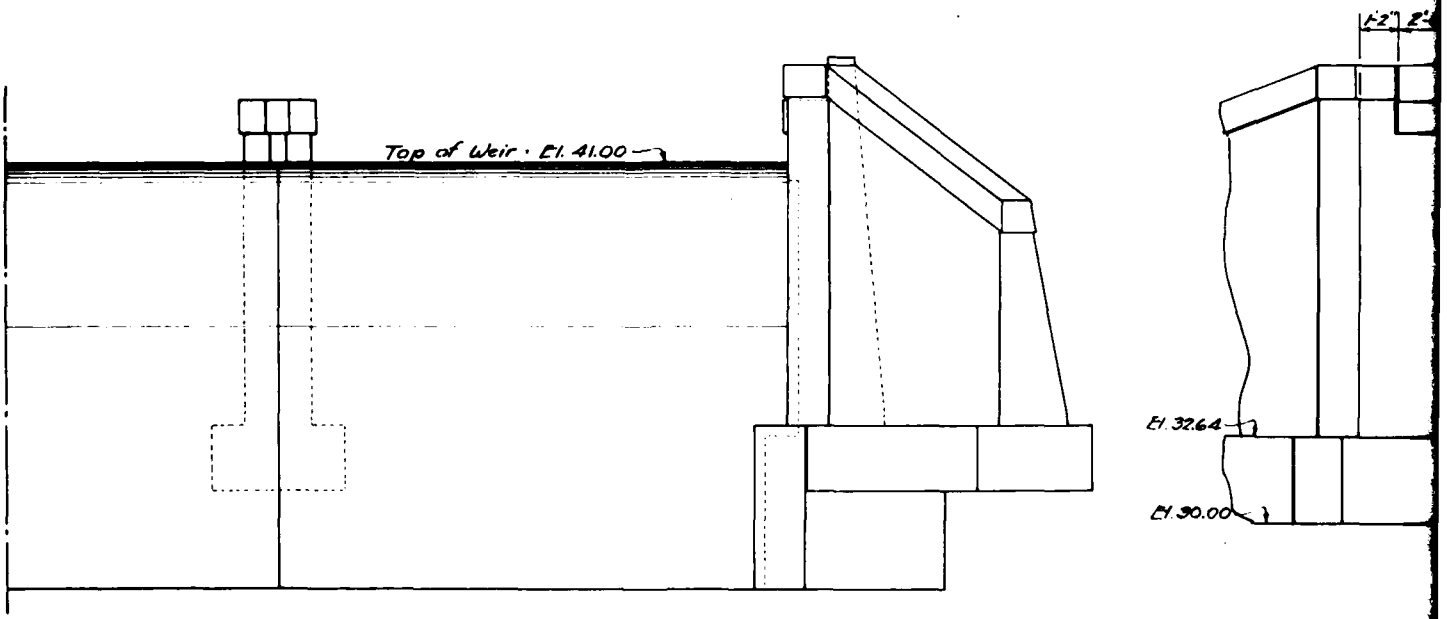
PA-00
PLATE



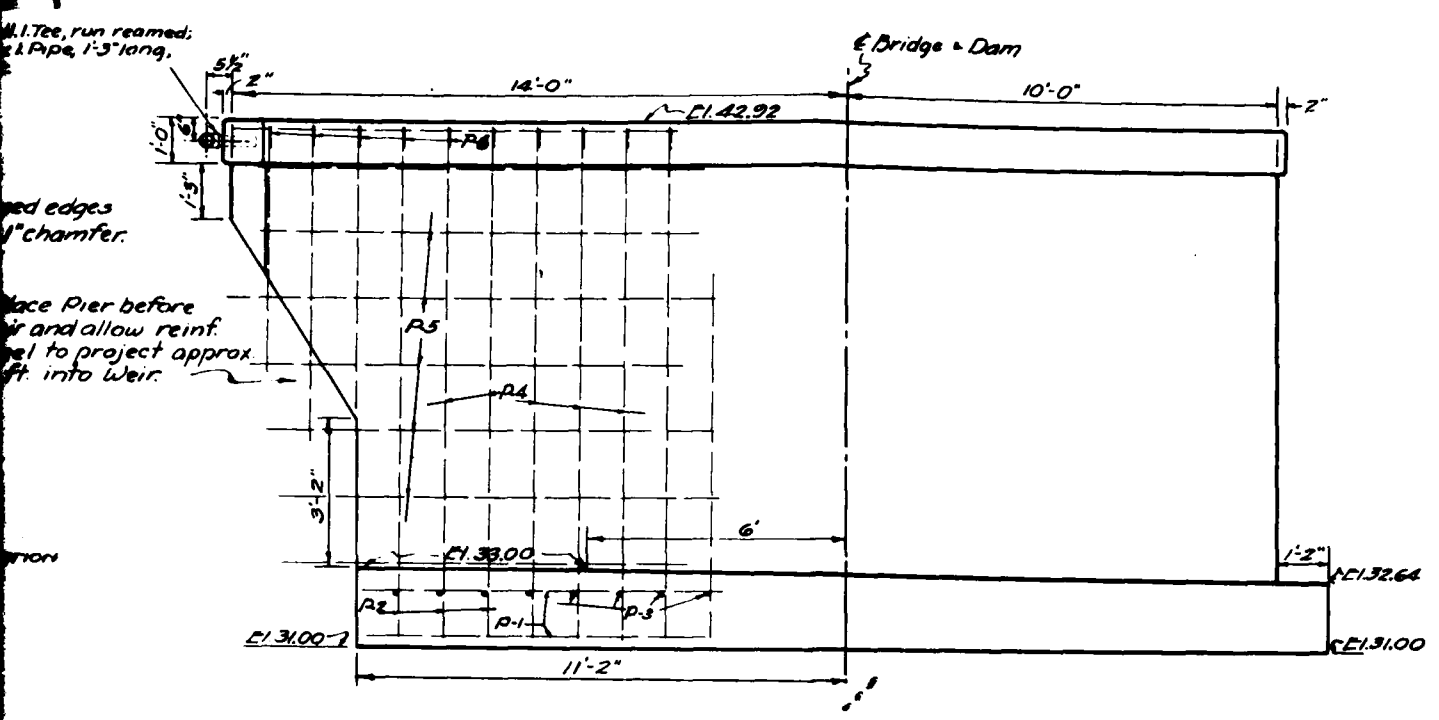
TYPICAL SECTION OF SPILLWAY WEIR
— SHOWING BRIDGE PIER —
SCALE: ½" = 1'



PIER — TYPICAL SECTION
SCALE: ½" = 1'

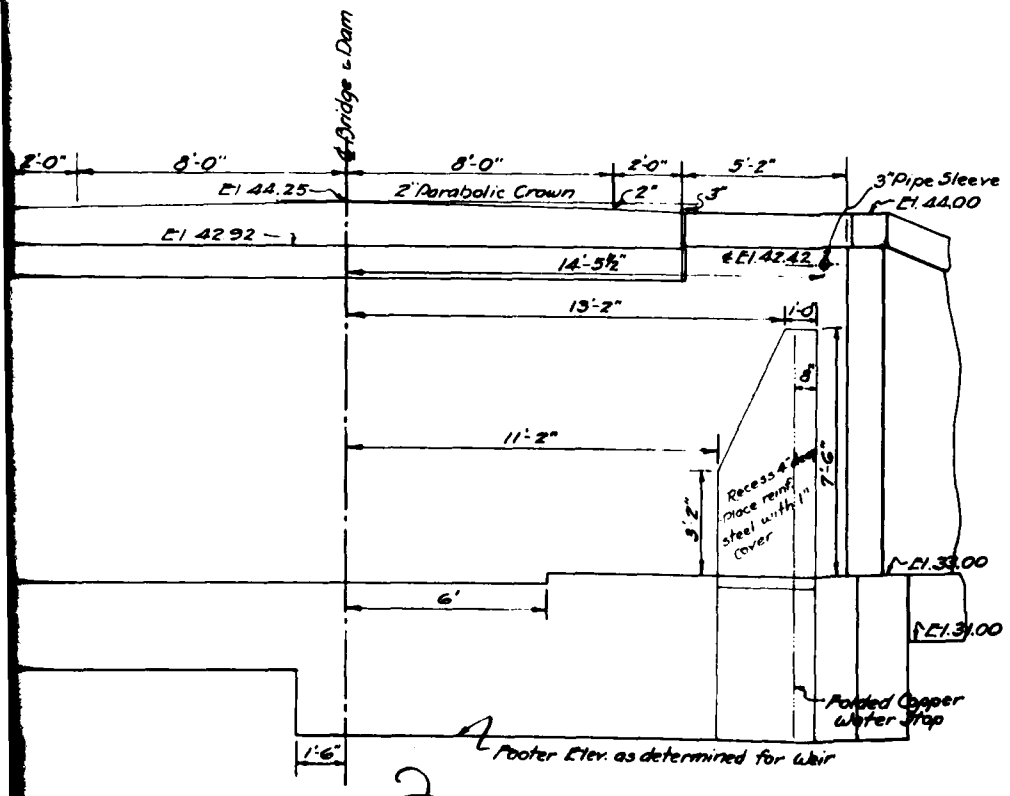


HALF UPSTREAM ELEVATION
— SUPERSTRUCTURE NOT SHOWN —
SCALE: ⅜" = 1'



PIER — ELEVATION

SCALE: 1½"-1'

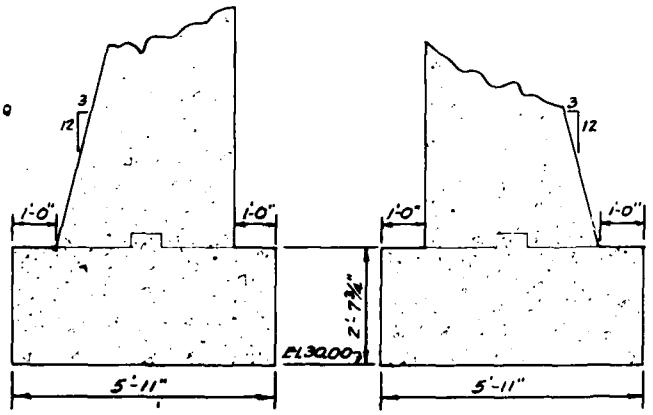


WEST ABUTMENT — ELEVATION
(EAST ABUTMENT OPPOSITE HAND)

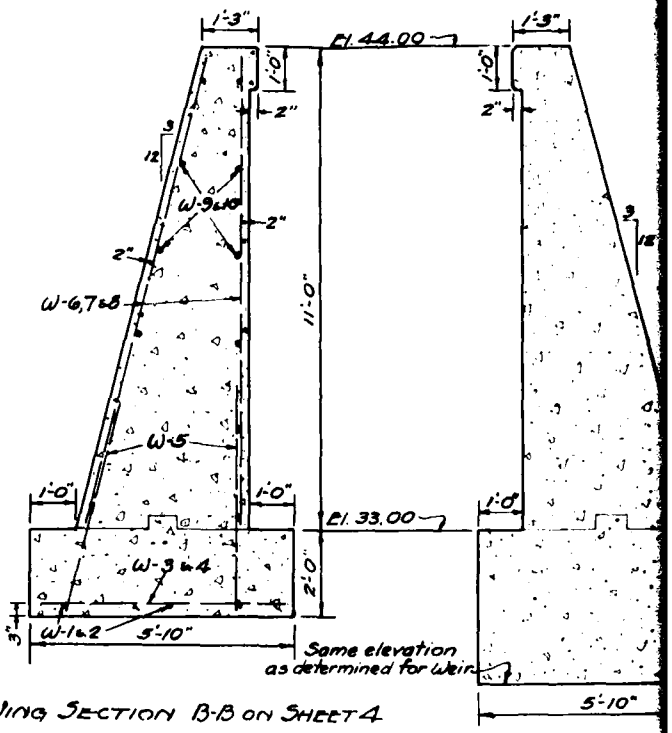
SCALE: 3/8"-1'

HEMLOCK FARMS, INC. LORDS VALLEY, PA.
LOWER LAKE DAM
WEIR & BRIDGE SUBSTRUCTURE VIEWS AND DETAILS
GEO. M. BREWSTER & SON, INC. ENGINEERING DEPARTMENT APRIL - 1945
Drawn | Checked | Approved | SHEET NO. 5 OF 8

PA-00
PLATE



PART WING SEC. D-D ON SHEET 4
-FOR REINFORCING SEE ABUT. SEC. A-A



WING SECTION B-B ON SHEET 4

PART WING SEC. F-F ON SHEET 4
-FOR REINFORCING SEE WING SEC. B-B

WING SECTION C-
-FOR REINFORCING S
AND SECTION AT

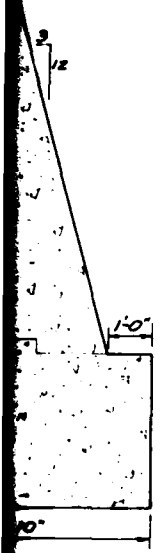
REINFORCING STEEL

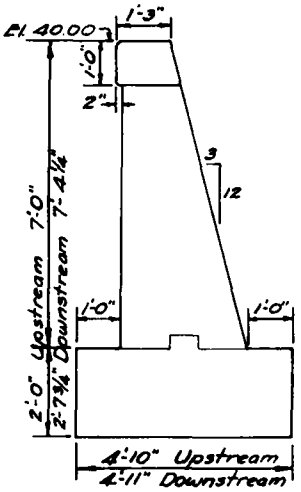
BAR	SIZE	NO.	LENGTH	SPAC'G.	WT.	LOCATION	DIAGRAM
VB-1	½" ø	56	10'-6"	12"	392	Valve Box Walls, inside	2'-0" 8'-6" for VB-1, 9'-8" for VB-2
VB-2	½" ø	56	11'-8"	12"	436	" " " , outside	
VB-3	¾" ø	72	14'-2"	12"	1,532	" " " , vertical	straight
VB-4	¾" ø	36	2'-6"	12"	135	" " , Wall dowels	
VB-5	½" ø	48	11'-6"	12"	368	" " Floor	straight | 1'-6" 12"
PC-1	½" ø	8	4'-6"	Shown	24	Pipe Cradles	straight
P-1	¾" ø	10	22'-0"	Shown	330	Pier Footers	straight
P-2	¾" ø	84	5'-8"	12"	715	" "	
P-3	½" ø	22	3'-6"	2'-0"	51	" "	straight | 4'-8" 42
P-4	¾" ø	96	9'-8"	12"	1,394	" Walls	straight
P-5	½" ø	34	23'-0"	1'-6" c shown	522	" "	straight | 1'-11" 5½"
P-6	⅝" ø	48	3'-6"	12"	175	" " , Seat	
A-1	⅝" ø	6	26'-0"	Shown	163	Abut. Footers	straight
A-2	¾" ø	32	4'-6"	2'-0"	216	" "	"
A-3	¾" ø	64	5'-0"	2'-0"	481	" " , dowels	"
A-4	1" ø	10	4'-0"	2'-6"	107	Abut.-Core Wall dowels	"
A-5	⅝" ø	32	9'-9"	2'-0"	325	Abut. Face, vertical	"
A-6	¾" ø	32	10'-9"	2'-0"	517	Abut. Back, "	"
A-7	⅝" ø	12	26'-0"	2'-0"	208	Abut. Face, horiz	"
A-8	⅝" ø	16	27'-0"	2'-0"	451	Abut. Back, "	"
A-9	⅝" ø	40	2'-8"	1'-0"	111	Abut. Seat	"
A-10	⅝" ø	10	2'-6"	As A-5	26	Abut. Winghead	straight | 1'-11" 9"
A-11	⅝" ø	4	2'-6"	8"	10	" " , dwnstrm	1'-0" for A-11, 5'-0" for A-12
A-12	⅝" ø	4	6'-6"	8"	27	" " , upstream	

BAR	SIZE	NO.	LENGTH
W-1	⅜" ø	6	7'-0"
W-2	⅜" ø	6	14'-6"
W-3	¾" ø	14	4'-9"
W-4	¾" ø	10	5'-3"
W-5	¾" ø	58	5'-0"
W-6	¾" ø	20	7'-0"
W-7	¾" ø	19	8'-0"
W-8	¾" ø	19	9'-6"
W-9	½" ø	24	7'-0"
W-10	½" ø	24	14'-6"
SW-1	¾" ø	40	12'-0"
SW-2	⅜" ø	16	15'-3"
SW-3	¾" ø	8	16'-0"
CW-1	¾" ø		8,000 lin.ft.
CW-2	½" ø		7,500 lin.ft.
SA-1	Filter Fabric		840 sq.ft.

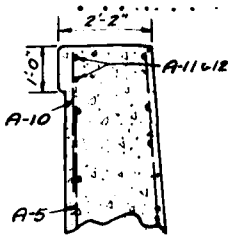
TOTAL

All exposed edges to have 1" chamfer.



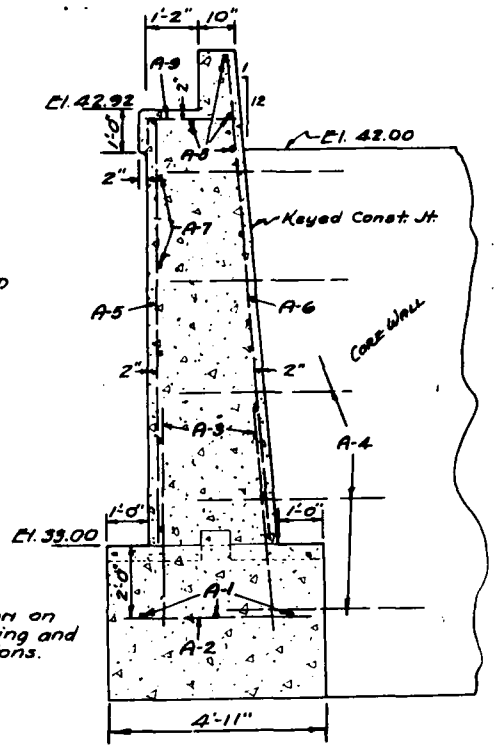


Wing - End View E-E on Sheet 4
- For Reinforcing See Wing Sec. B-B -



Section at Winghead

All Scales: ½" = 1'



See Elevation on Sheet 5 for footing and backwall elevations.

Bridge Abutment —
Section A-A on Sheet 4

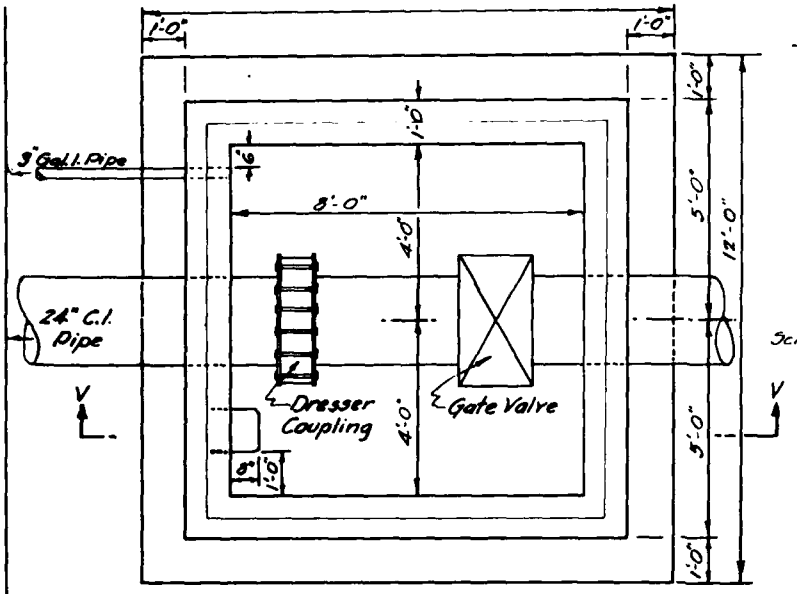
...n C-C on Sheet 4.
...ng See Abut. Sec. A-A
... at Winghead

...TH	SPAC'G.	WT.	LOCATION	DIAGRAM
..."	Shown	44	Wing Footer, upstream	straight
...;"	Shown	91	" " , downstream	"
...	2'-0"	100	" "	"
...	2'-0"	79	" "	"
..."	As W-6,7,8	436	" " , dowels	"
...	1'-6" Back	210	Wing, vertical	"
...	2'-0" Face	228	" , "	"
...		271	" , "	"
...	2'-0"	112	Wing, horiz., upstream	"
...	2'-0"	232	" , " , downstream	"
...	1'-3"	721	Weir, vertical	7'-8" 4'-4" 1'-0"
...	1'-6"	366	" , horiz., end spans	straight
...	1'-6"	192	" , " , middle span	"
...ft	12"	12,016	Core Wall, vertical	straight, cut to fit
...ft	1'-6"	5,003	" " , horiz.	" " "
...ft		353	Spillway Apron	
		29,170		

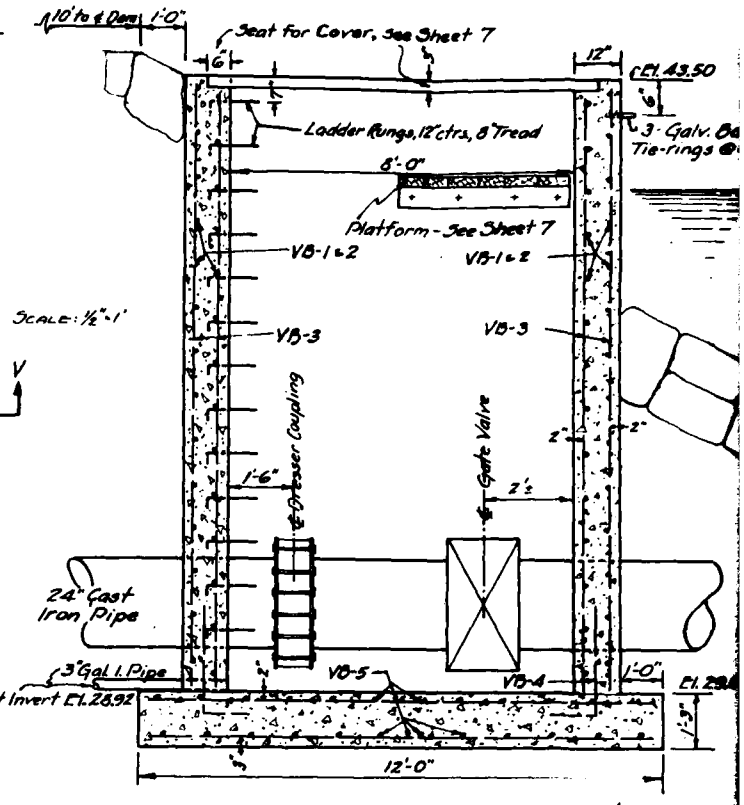
2

HEMLOCK FARMS, INC. LORDS VALLEY, PA.
LOWER LAKE DAM
BRIDGE SUBSTRUCTURE DETAILS REINFORCING STEEL SCHEDULE
GEO. M. BREWSTER & SON, INC. ENGINEERING DEPARTMENT APRIL - 1945
Drawn / Chkd / Approved — SHEET No. 6 of 8

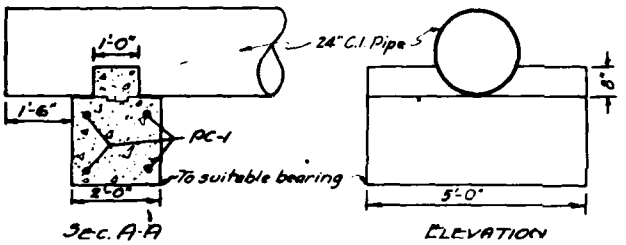
PA-0
PLAT



VALVE BOX — PLAN
— COVER NOT SHOWN —
— PLATFORM NOT SHOWN —



VALVE BOX — SEC. V-V

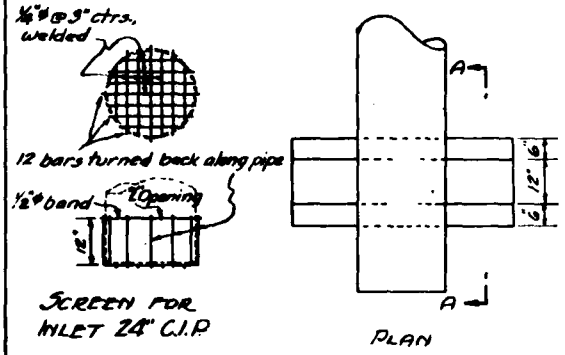


SEC. A-A ELEVATION

— NOTES —

Location of 24" C.I. Pipe shall be such that the inlet will
ing ground and outlet will have straight discharge without
pipe shown are sufficient for moderate skew. 3" Galv. I. P
allel to 24" C.I. Pipe. Inlet end of 24" C.I. Pipe, as laid, shall b
line measurement so that same may be located without th
24" Valve to be provided with long or extension stem so
will be at Elev. 42.5±

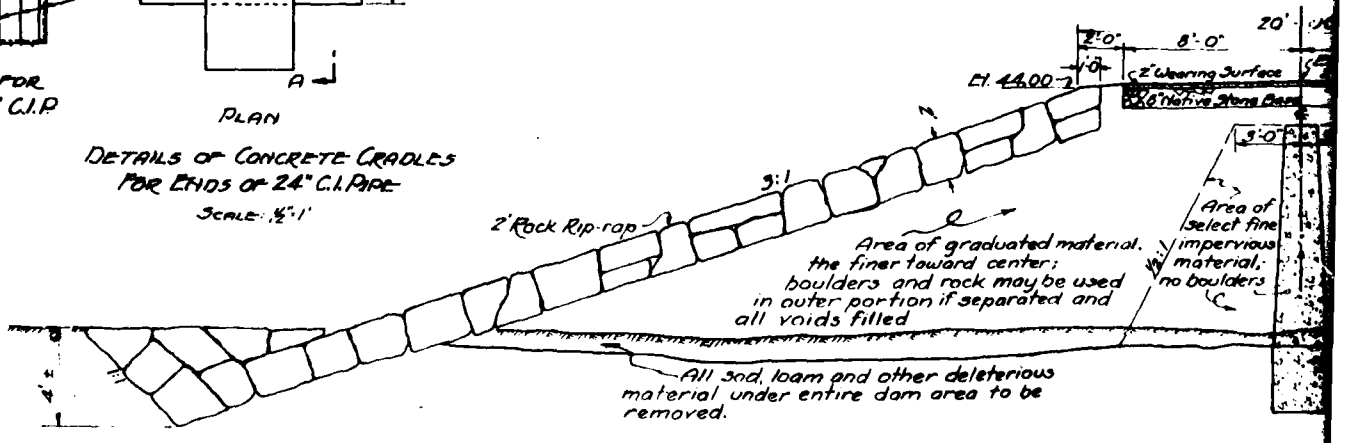
24" Dresser Coupling shall be of size to properly fit the
3" Galv. I. Pipe shall be threaded and coupled and laid o
Screen for Inlet 24" C.I.P. shall be painted with asphalt



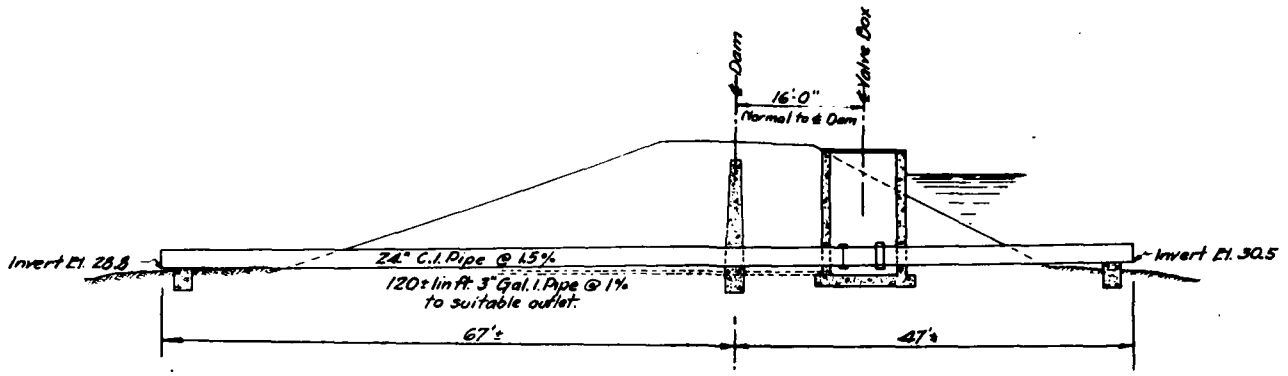
SCREEN FOR INLET 24" C.I.P.

PLAN

DETAILS OF CONCRETE CRADLES FOR ENDS OF 24" C.I. PIPE
SCALE: ½"-1'

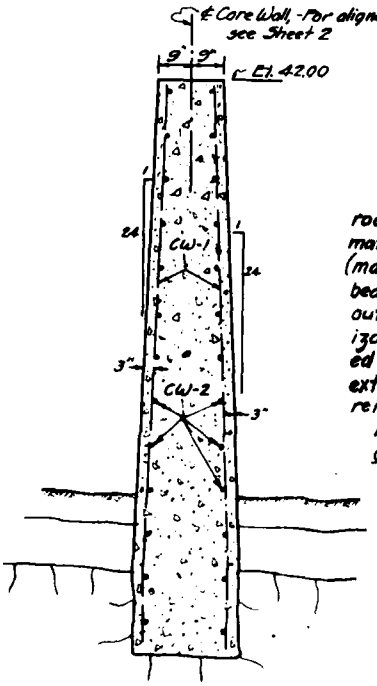


TYPICAL CROSS-SE
SCALE-



SECTION THRU VALVE BOX AND EMERGENCY OUTLET

SCALE: 1"=10'



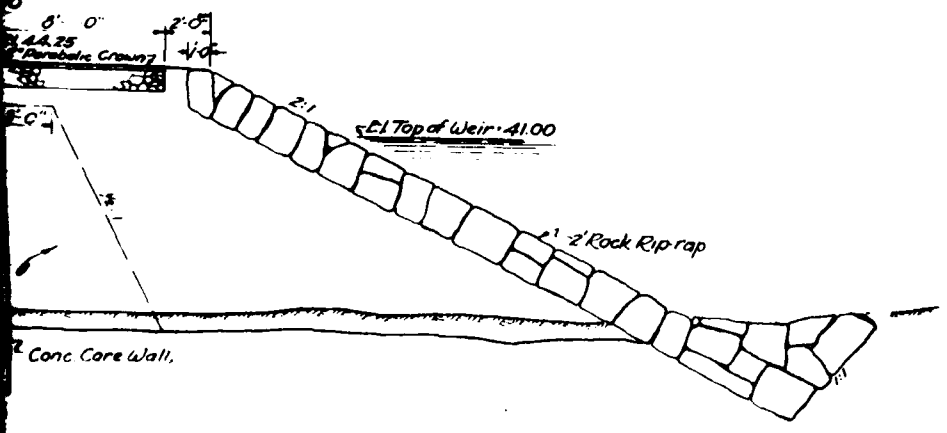
CORE WALL — TYPICAL SECTION

—NOTES—

Core Wall to be imbedded a minimum of 2 feet in rock or 4 feet in clay or other suitable impervious material except end monoliths and two middle monoliths (marked * on Profile on Sheet 2) which shall be embedded in rock. Concrete to be placed in same without forms. Special effort shall be made to avoid horizontal construction joints. All joints to be provided with keys, min. 4" x 8". No reinforcing steel shall extend thru vertical construction joints. Splices in reinforcing steel shall be made by laps of 40 diameters. For Reinforcing Steel schedule and details see Sheet 6. Concrete Mix, unless otherwise shown, shall be 1:6½.

be at least 1 foot above exist-
ut excessive wash. Lengths of
ipe need not necessarily be par-
e accurately referenced by single
e use of instruments.
that hand wheel, when closed,

pecific weight of 24" C.I. Pipe used
n even grade to drain.
t metal paint.



CTION OF DAM
= 1'

2

HEMLOCK FARMS, INC. LORDS VALLEY, PA.
LOWER LAKE DAM
DAM TYPICAL SECTION VALVE BOX, EMERGENCY OUTLET CORE WALL TYPICAL SECTION
GEO. M. BREWSTER & SON, INC. ENGINEERING DEPARTMENT APRIL - 1945
Designed | Checked | Approved — SHEET NO. 3 OF 8

PA-0
PLATE

APPENDIX F

GEOLOGIC REPORT

LOWER HEMLOCK DAM

Bedrock - Dam and Reservoir

Formation Name: Long Run - Walcksville Member of the Catskill Formation.

Lithology: Predominantly medium to coarse grained, greenish gray to medium gray sandstone, interbedded with red shale, claystone and siltstone. The sandstone is very thick, bedded with distinct cross lamination. The beds are arranged in upward fining cycles, ten to hundred feet thick. Locally lenses of calcite cemented conglomerate are present at the base of the cycles; but these lenses rarely extend more than a few tens of feet laterally.

Structure

The dam is located in the Pocono Plateau and the beds are essentially horizontal. There is a very low regional dip in the northwest. No faults are mapped in the vicinity.

A dominant air photo fracture trace trend is N5° - 10°E. A second trend is N65°E.

Overburden

There is no information in the file relating to borings or test pits. The site is within the limits of Pleistocene glaciation and a variable thickness of till can be expected to be present. Outwash sands and gravels commonly occur in the valleys.

Aquifer Characteristics

The rocks of the Catskill Formation are essentially impermeable, and ground water movement is entirely along bedding planes and fractures. The very strong set of air photo fracture traces trending N10°E probably represent important ground water movements in these zones. The most permeable aquifers in the area are in the sands and gravels of the glacial outwash in the valleys.

Discussion

The plans of this dam indicate that it has a concrete core wall which was to be set two feet into rock, or four feet into clay or other impervious material. It is not known if any rock was encountered. There are no reports of inspection during construction because, in fact, the dam was built without a permit, and the

permit was granted after the construction was completed. The dam is built across a N10°E fracture trace. This represents a possible channel for leakage throughout the bedrock below the core wall.

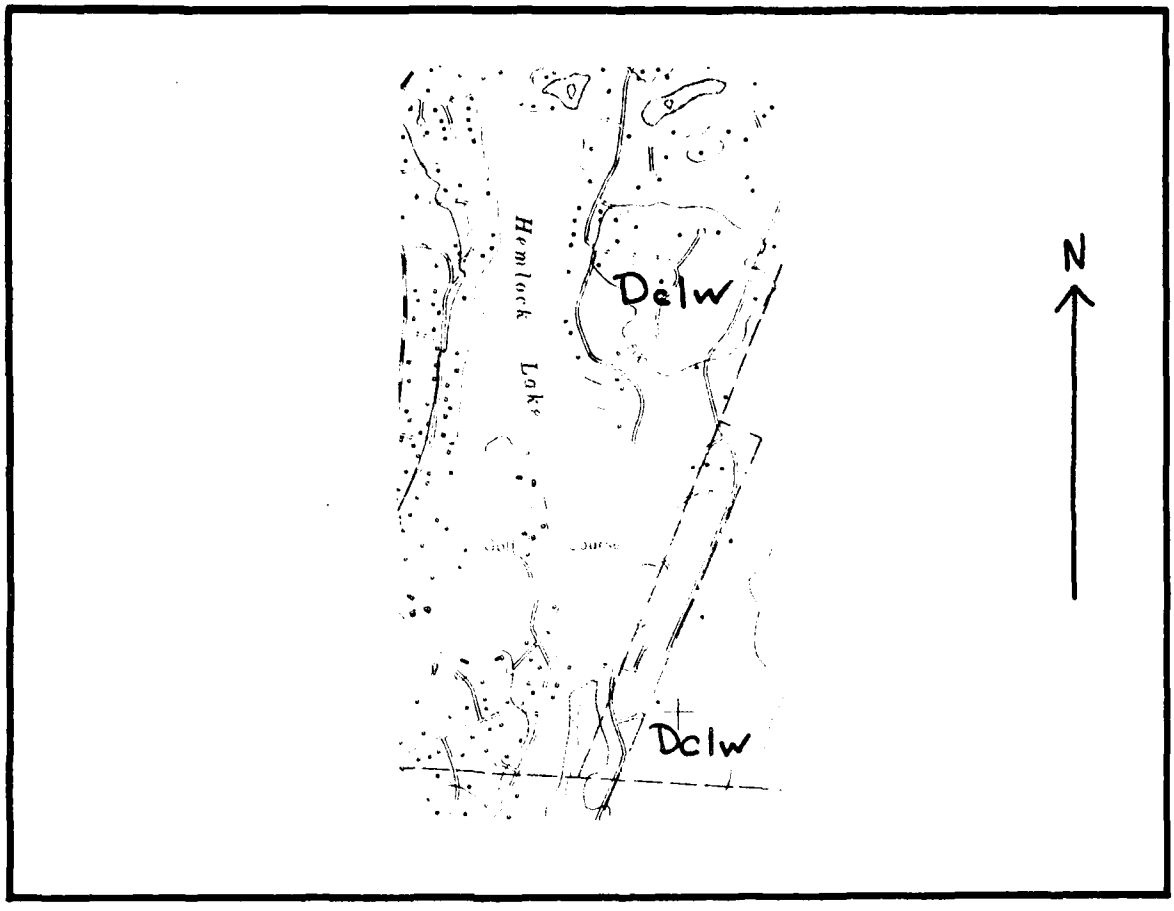
Sources of Information

1. Sevon, W.D., et al., "Geology and Mineral Resources of Pike County," open file report, Pa. Geologic Survey, Harrisburg, Pa.

2. Air photographs dated 1973, scale 1:40,000.

3. Plans and inspection reports in file.

GEOLOGIC MAP - Lower Hemlock Dam



Dclw — Catskill Fm.- Long Run/Walcksville member

— · — · air photo fracture trace

SCALE 1 24000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET